Research Article

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Integration effect of artificial intelligence and traditional animation creation technology

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Abstract: Despite the advancements in modern computer hardware and software, the creation of digital animation still demands a substantial investment of both manpower and time. This article aimed to explore how artificial intelligence (AI) technology can be combined with traditional animation creation techniques to achieve better integration effects. By combining intelligent character animation generation with hand drawing, a generative adversarial network was used to achieve high-quality animation generation. The generator generated realistic animations, and the discriminator measured the authenticity of the animations by comparing the differences between the generator-generated animations and the real animations, which was used for automated character animation generation. This can greatly reduce the cost and time of digital animation creation, improve the quality of digital animation, and provide more innovation for the application of traditional animation technology. The average number of audience attracted by characters through blended creation was 122.2% more than that of characters through traditional animation creation and 32.6% more than that of characters through AI creation. This not only helps animation producers complete animation production more quickly, but also enhances the creativity and artistic value of animation.

Keywords: artificial intelligence, generative adversarial network, traditional animation creation, character animation, integration effect

1 Introduction

The booming development of the animation industry and the explosive dissemination of information in the post-Internet era have provided audiences with more choices and diverse aesthetic needs, and the demand for animation content is also increasing day by day. 3D animation has become mainstream due to its efficient and standardized production, and in this context, it is particularly important to think about how animation art can achieve innovation. With the continuous development and application of artificial intelligence (AI) technology, it has played an important role in the field of traditional animation creation, making the production of animated films more efficient and accurate. Traditional animation creation technology is a technology with a long history, which requires the use of the creator's hand-drawing skills and creativity to complete animation design.

Traditional animation production is gradually becoming digitized, requiring more efficient workflows and new technologies to adapt to this change. Contemporary animated films are often described as being able to

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evoke emotional responses from their growing audience, and character animation is the core of understanding audience narrative interaction. van Rooij Malou discussed how character animation design styles play an important role in the emotional potential of these movies. When presenting specific types of character shaping, the audience's level of empathy reached a climax [1]. In the collaborative development of character animation technology and tools, Yoshida Naoto introduced practical methods for developing many behaviors within a single robot agent. In addition, he summarized how traditional character animation techniques are applied and what new technologies are needed from the perspective of professional animation creators [2]. Ribes Xavier examined over 3,300 videos published by 25 animation channels between 2006 and 2018 to analyze how changes in platform policies have influenced and shaped the evolution of internet animation production [3]. The advancement of machine learning has made the surreal synthesis of image, audio, and video data possible, which is known as the media generated by AI. These technologies provide new opportunities for creating interactions with animation, which can stimulate the inspiration and interest of animation creators. Pataranutaporn Pat emphasized the positive use cases of AI-generating character animations, demonstrating an easy-to-use AI character animation generation channel to achieve vivid animation effects [4]. The competition in the animation industry is becoming increasingly fierce, and creators need to produce content faster and more efficiently and create more influential works to meet the needs of audiences. With the advent of the digital media era, animation has also become a form of film and television art, with increasingly rich forms and content, which can bring intuitive visual stimulation to the public.

The development of digital media has driven innovation in animation technology, and the emergence of various animation expression methods and production software has injected new vitality and energy into animation teaching. In the actual teaching process, it is necessary to adapt to the changes in presentation forms and teaching modes as soon as possible, in order to cultivate more excellent animation professionals. Shuo Sun started with an overview of the digital media era and its impact and analyzed the forms of animation in the digital media era. Based on this, he proposed several strategies from clarifying the demand for animation professionals in the new media era, and innovating and optimizing animation teaching courses in the digital media era [5]. In human–computer interaction, robots have many different ways of moving, and one method is to use techniques from movie animations to guide robot movement. Schulz Trenton found that animation technology has improved the interaction between individuals and robots, increased their perception of robot quality, understood robot intentions, and displayed robot states or possible emotions. Animation technology can also help people establish connections with robots that are not like humans or robots [6]. Lee Kyungho proposed a method for learning actions from raw motion data in interactive character animations and used recurrent neural networks to handle spatiotemporal constraints and structural changes in human motion. If it handles the actions of a single character animation, the learning process is completely automated, and if it handles the interaction between props and multiple characters, it requires minimal user intervention [7]. Choi Jong-In studied the development and motion control of 3D character animation and discussed the direction of technological development. Character animation has developed into a data-driven and physics-based approach, and various effective techniques for editing motion data have emerged. The use of machine learning animation techniques has shown new possibilities for creating characters that can be controlled in real-time by users, and is expected to be developed in the future [8]. The integration of AI and traditional animation creation technology has brought many innovations and developments to the animation industry, bringing new technological means to traditional animation creation.

AI provides creators with new creative ideas and possibilities, creating unique artistic styles or exploring new visual effects through generative adversarial network (GAN). By utilizing AI technology, animated content can better adapt to personalized needs, such as automatically generating content based on user preferences or providing interactive experiences. Based on GAN, multiple loss functions were combined to increase the stability of GAN and improve the quality of scene generation, thereby achieving high-quality generation of specific scenes. Blended creation can improve the production efficiency and quality of animation works, while also providing creators with more creative tools and possibilities.

2 Animation creation based on AI

Since its inception, the development of animation has been inseparable from the strong support of technology. The emergence of animation predates movies, and technological innovation has driven the development and innovation of animation art. The diversity of technological means has changed the way animation is produced [9,10]. In the process of animation production, from color animation and audio animation to the intervention of computer animation technology and stereoscopic imaging technology, the rapidly developing technology has brought new vitality to animation.

Before entering the field of art, AI was first applied to people's daily lives. AI has received attention and recognition from many fields in its ability to imitate and emulate the intelligence of individuals, gradually being applied to people's daily lives and work as an extension of their mental and intellectual abilities.

The first trailer of the Chinese produced animation "Divine Chord: Cats and Time Bells" has been released, with antique visuals. Two-thirds of the background of this trailer is made in conjunction with AI.

In modern society, AI technology is increasingly being widely applied in various fields, including animation creation. Through the integration with traditional animation creation techniques, AI technology has played a great role in animation creation [11,12]. The use of machine devices in artistic creation, similar to the derivative of creative styles by creators, and the development of AI have led to machine devices possessing the human like "brain" that can collect, process, and output information, forming a complete system [13,14].

3 Integration of AI and traditional animation creation technology

3.1 Combination of intelligent character animation generation and hand drawing

In traditional animation, most of the visuals need to be hand-drawn based on the storyline. The use of AI technology can automatically generate some basic images, thereby reducing the time and cost of hand-drawing production [15,16]. However, AI technology cannot completely replace hand-drawing technology, and creators need to make fine adjustments and render to the automatically generated images.

One method of using AI technology to automatically generate character animations is to use GAN, which consists of a generator and a discriminator. The generator gradually generates more realistic images [17,18].

The training process of GAN is a game process. The generator attempts to generate realistic images to deceive the discriminator, while the discriminator attempts to accurately recognize real images. GAN does not require paired datasets to achieve the transfer of two different animation styles. The generator and discriminator of GAN both use a convolutional network structure to extract features. The generator includes a convolutional structure for downsampling and a deconvolution structure for upsampling [19,20].

The relevant content is inputted, and animation generation is carried out through the encoder and decoder. Finally, the results are obtained through discrimination.

The goal of the encoder is to extract the features of the scene in the input image and form a corresponding relationship with the features of the target scene image. Choosing an encoder as part of the generator is not only necessary to extract fine features of the input scene, but also to generate new animation scenes based on the input image. The encoder can extract more features and transmit more information to the next layer [21,22].

Replacing spectral normalization with gradient normalization in the discriminator makes the gradient space of the discriminator smoother without compromising its performance. Spectral normalization is a weight normalization technique used in deep neural networks, aimed at stabilizing and accelerating the training process of models such as GANs, and improving the model's generalization ability. Gradient normalization replaces the module-level constraints imposed by the traditional normalization function on the model with model-level constraints, enhancing the ability of neural networks.

By the maximum-likelihood estimation, given a P_{data} distribution of real data, the machine is asked to learn a distribution P_{G}. By sampling the set of samples, the probability of generating distribution $P_{\text{G}}(x, \theta)$ is obtained through a generator P_{G} and a parameter θ:

$$\theta = \int P_{\text{data}}(x) \log P_{\text{G}}(x, \theta)\mathrm{d}x - \int P_{\text{data}}(x) \log P_{\text{G}}(x)\mathrm{d}x. \tag{1}$$

Maximum-likelihood estimation is a common parameter estimation method used to estimate model parameters based on observed data. GANs have functions such as capturing the distribution of sample data. The distribution of input sample data can be biased toward the specified distribution of data samples by controlling the direction of training data through the maximum-likelihood estimation.

In the past, Gaussian distribution was used to fit the data distribution of images, but the fit between Gaussian distribution and the data distribution of images was not high, resulting in low image quality. The objective function is the function that needs to be minimized or maximized in optimization problems. In machine learning, optimization, and mathematical modeling, the objective function is usually defined as the quantity that needs to be optimized or the error that needs to be minimized. The complex objective function is learned through a generative network, and the objective function of the generator is given in the following formula:

$$J = \min D(P_{\text{G}}, P_{\text{data}}). \tag{2}$$

The purpose of GANs is to generate sample domains that are very close to the real samples, allowing the discriminator to make extremely rigorous judgments on the generated samples, which is an ideal situation. The training cost is evaluated, which includes the parameters of the generator and discriminator. The training process of the generative network can be represented by the following formula:

$$T_{\lambda} = \frac{P_{\text{G}}}{P_{\text{data}}}. \tag{3}$$

By performing variational inference on the input real sample data, the posterior probability value of the latent variable is calculated. The probability of the occurrence of hidden variables is obtained by inputting random variables, and then, the hidden variables are sampled from a posterior probability through a generative network, ultimately restoring a probability distribution similar to the input data. The generation process is shown in the following formula:

$$p(x) = \int_{z} p(z)p(x|z)\mathrm{d}z. \tag{4}$$

Variational autoencoder is a generative model commonly used to learn potential representations of data and generate new data samples. In the training of variational autoencoders, the technique of reparameterization is incorporated, and the entire process can be summarized as inputting an image into the encoder. Then, after reparameterization, the new latent variable is obtained as input to the generator.

The autoregressive model ultimately generates a discrete sequence, so it also models the pixels in the image through discrete distribution:

$$p(x)\prod_{i=1}^{n} p(x_1|x_2L,\ x_{i-1}). \tag{5}$$

Among them, x_{i-1} represents the $i-1$-th pixel of the image. Given the previously generated pixels, the data distribution of the image can be obtained by multiplying the corresponding pixels of all pixels. When using autoregressive models for image generation, it is done in a sequential manner, generating pixel by pixel from left to right and from top to bottom, and GANs directly generate complete images in parallel.

AI technology can play a great role in the automatic generation of character animations. The production of traditional character animation requires multiple steps, including building a 3D model, adding bone animation, drawing textures, and setting materials. These steps require manual operation by the creators, which is time-consuming and laborious and also requires a lot of experience and skills. However, through AI technology, production efficiency and quality can be greatly improved [23,24].

3.2 Automatic generation of environmental scenes combined with hand drawing

GAN can not only be used to generate realistic animated images, but also to generate realistic scenes and environments. Similar to character animation, GAN is used to learn scene features and patterns from a large amount of scene data, and then, these features are used to automatically generate environmental scenes [25,26].

The generation of specific scenes refers to the generation of a new scene image containing objects in the input scene, given an input scene image and using semantics or other scenes as input control conditions. The generation of specific scenes is a challenging task, as it is not simply about regenerating learned objects, but about first learning the meaning represented by each image. Then, under the control of external conditions, the recombined scene is generated, and the state, position, and size of the input original scene also change, making the generated scene reasonable. The emergence of GAN provides ideas for this method [27,28].

The GAN can be viewed as a mapping from random noise to output discrimination results. The random noise is input into the generator, which maps the received random noise to a new data space and passes the results to the discriminator [29,30].

In the model, the generator maps the original input scene image to a scene image similar to the target label, so the training dataset is given as a set of joint scene images (x, y). Among them, x is the input image and y is the corresponding target image. The loss function is a key concept in machine learning and optimization, used to measure the difference or error between the predicted values of a model and the true values. The loss function of the discriminator determines whether the input scene is real or generated by the generator. The loss function of the generator is given in the following formula:

$$G = -E_{x,y}[\log(1 - D(x, y))]. \tag{6}$$

The overall loss function generated by the scene can be expressed as:

$$V(G) = E_{x,y}[\log D(x, y)] + E_{x,y}[\log(1 - D(x, y))]. \tag{7}$$

As the loss function of the adversarial model, when inputting real scene images, the discriminator attempts to make the objective function as large as possible and determine that it is a real image [31,32]. When inputting the generated scene image, the generator attempts to make the objective function as small as possible, i.e.,

$$G^* = \arg\max V(G, D). \tag{8}$$

To make the generated scene as similar as possible to the real scene, the value of the loss function is relatively large, and the generator deceives the discriminator and mistakenly assumes that the input is a real image. At the same time, the discriminator attempts to identify it as a fake image, and these two models confront each other until Nash equilibrium is reached. Nash equilibrium refers to the state in which each participant makes the optimal decision in a game. When the strategies of other participants are fixed, each participant is unable to obtain better returns by changing their own strategies.

In order to make the scene graphics generated by the generator more realistic, a loss function is used to make the generated scene as similar as possible to the target scene. Other loss functions, including loop loss functions, are compared. The loop loss function is as follows:

$$V_{L1}G = E_{x,y}\|y - G(x, y)\|. \tag{9}$$

In image generation tasks, the evaluation of the quality of the generated image results cannot rely solely on subjective judgment of human visual perception. Quantitative analysis of the generated image is also necessary, mainly considering two aspects: the quality of the generated image itself (i.e., whether the content of the image is realistic and whether the details of the image are clear) and the diversity of the generated images. A good way to generate images should be diverse rather than generating fixed types of similar images.

Inception score (IS) is one of the indicators used to evaluate the quality of generated images in GANs. It is mainly based on the feature extraction capability of inception networks (a deep convolutional neural network used for image classification and recognition). IS uses pretrained inception neural networks as classifiers, inputs image samples generated by the generator into the classifier, and performs statistical analysis on the output values of the classifier. The calculation formula is as follows:

$$\mathrm{IS}(G) = \exp(E_{x-p_g}\mathrm{KL}(p(y|x)\|q(y))). \tag{10}$$

Among them, E_{x-p_g} represents the generated image sample; $\mathrm{KL}(p(y|x)\|q(y))$ represents using KL divergence to measure the distance between distribution p and q; and $p(y|x)$ represents the edge distribution of all-category images. The larger the $\mathrm{IS}(G)$, the better the image effect generated by the generator model.

The image quality is evaluated by calculating the distance between the feature vectors of the real image and the generated image, while the feature vectors of the image are extracted by removing the last layer of the network through the inception neural network. The calculation formula is as follows:

$$Q(P_r, P_g) = \|\mu_r - \mu_g\|. \tag{11}$$

Real image samples and generated image samples are Gaussian-modeled in multidimensional space. Among them, μ_g represents the trace of the matrix. If $Q(P_r, P_g)$ is smaller, it indicates a higher degree of similarity between the generated image and the real image, indicating a better generation effect of the model.

AI technology can also play a huge role in the automatic generation of environmental scenes. The production of environmental scenes requires knowledge in multiple aspects, such as modeling, texture, and lighting. In traditional animation production, a rich team of scene designers, modelers, and texture creators are usually required to complete these tasks. However, using AI technology, these tasks can be delegated to machines to complete.

3.3 Combination of motion capture and hand drawing

The application of AI in the field of motion capture, combined with traditional hand-drawn animation, provides creators with more possibilities. Combining the two can improve animation production efficiency and realism. Motion capture technology utilizes sensors to capture motion in the real world and convert it into digital form, while traditional animation involves manually drawing each frame. In traditional animation, creators need to draw each frame by hand, and intermediate transition frames also need to be hand-drawn. However, using automatic frame insertion technology can automatically insert intermediate frames, thereby reducing production time and improving image quality. However, automatic frame insertion technology cannot completely replace hand-drawing technology, and creators need to finely adjust and render the automatically generated frames.

Motion capture technology uses sensors or cameras to capture human motion, and then, it converts it into digital animation frames through computer graphics technology. This technology can greatly improve production efficiency and animation quality. Motion capture technology is commonly used in fields such as film and television production, game development, medical research, and sports training.

Linear interpolation is one of the commonly used methods for processing motion data, as shown in the following formula:

$$P(t) = P_0 + (P_1 - P_0)\cdot t. \tag{12}$$

Formula (12) describes the interpolation process of motion between two keyframes. Among them, $P(t)$ represents the position at time t, and P_0 and P_1, respectively, represent the position data of two keyframes.

Quaternion is a mathematical structure used to describe rotation and direction and is a hypercomplex number composed of one real part and three imaginary parts. Quaternions are widely used in rotation and motion capture. For interpolation between two quaternions q_0 and q_1, spherical linear interpolation can be used:

$$\mathrm{Slerp}(q_0, q_1, t) = \frac{\sin(1-\theta)}{\sin(\theta)}q_0 + \frac{\sin(1-\theta)}{\sin(\theta)}q_1. \tag{13}$$

Among them, θ is an angle between q_0 and q_1.

The combination of motion capture technology and AI technology can use real human motion data for machine learning, learn the rules and characteristics of actions from it, and then apply it to animation creation. For example, motion capture data can be used to train neural networks to automatically apply most of the character actions learned from real human motion to animation.

4 Effect of blended creation

4.1 Improving creative efficiency

The establishment of traditional animation production methods and industrial processes has led to the production of high-quality animation being only suitable for large teams or companies, which is not conducive to the incubation and development of independent creators and small teams. Therefore, it is urgent to establish a more efficient and stylistic creation mode for the cultivation of animation talents in the new era.

Animation creation covers a wide range of fields including movies, advertising, games, entertainment, and educational animation. This article focused on creating 225 characters and 225 scenes in these fields. The creative efficiency of traditional animation creation, AI creation, and blended creation (the integration of AI and traditional animation creation technology) was compared, as shown in Table 1 (the data in the table is the average creation time of each character).

Table 1: Average time spent creating characters using different methods (minutes)

Type and average	Traditional animation creation	AI creation	Blended creation
Film	58.51	26.81	21.99
Advertisement	50.84	33.21	20.27
Game	57.64	31.60	24.80
Entertainment	56.47	27.56	24.13
Teaching animation	69.53	29.41	16.70
Average	58.60	29.72	21.58

As shown in Table 1, the average time for traditional animation creation, AI creation, and blended creation of characters was 58.60, 29.72, and 21.58 min, respectively. Among them, the average time for characters through blended creation was the least, which was −63.2% $\left(\frac{21.58-58.60}{58.60}=-63.2\%\right)$ longer than the average time for traditional animation creation. In other words, the average time for characters through blended creation was 63.2% less than the average time for characters through traditional animation creation.

The average time for creating scenes using different methods is shown in Table 2 (the data in the table represent the average creation time for each scene).

Table 2: Average time spent on creative scenes by different methods (days)

Type and average	Traditional animation creation	AI creation	Blended creation
Film	7.19	3.12	0.85
Advertisement	9.68	3.07	0.79
Game	8.04	2.50	1.15
Entertainment	7.32	3.29	1.28
Teaching animation	5.45	3.02	0.92
Average	7.54	3.00	1.00

As shown in Table 2, the average time for scenes through traditional animation creation, AI creation, and blended creation was 7.54 days, 3.00 days, and 1.00 days, respectively. Among them, the average time for the blended creation scenes was the least, which was −86.7% $\left(\frac{1-7.54}{7.54} = -86.7\%\right)$ more than the average time for traditional animation creation scenes, meaning that the average time for blended creation scenes was 86.7% less than the average time for traditional animation creation scenes.

The average time for blended creation scenes was lower than that of the scenes through traditional animation creation and AI creation, indicating that the efficiency of blended creation scenes was high.

The application of blended creation can greatly improve the efficiency of animation production. For example, in traditional animation production, “inbetween” production requires the animation creator to draw keyframes and the last frame, and then, AI automatically generates intermediate transition frames. The traditional animation creation process is very time-consuming for animation creators, requiring multiple modifications and experiments. By incorporating AI technology, it is easy to achieve automatic generation of inbetween, greatly improving the efficiency of animation production.

In the rigorous workflow of animation creation, the most valuable aspect of collaborative work between people is communication, because creators use images to “speak” in this process. Whether it is the director or art director, they must interpret and explain the design intent, modification methods, and other content to the collaborating personnel based on the content of the painting. Therefore, blended creation has unparalleled value compared to other software, because when combining cross-dimensional content, it is necessary to check the appropriateness of content integration during the process. The application of non-linear production tools greatly reduces the steps and time costs of modification and adjustment.

4.2 Saving creative costs

Traditional animation production is a very labor-intensive and material task that requires professional animation creators to draw every frame, and requires multiple modifications and polishing. The production process is prone to errors, requiring rework, which increases production costs and time costs.

The average cost of traditional animation creation, AI creation, and blended creation of characters and scenes is shown in Figure 1 (the horizontal axis in Figure 1 represents the type of creation; the vertical axis represents the cost, and the unit is yuan).

As shown in Figure 1, the left side of Figure 1 represented the average cost of characters through traditional animation creation, AI creation, and blended creation, which were 5365.7 yuan, 4056.6 yuan, and 1377.2 yuan, respectively; the right side of Figure 1 represented the average cost of scenes through traditional animation creation, AI creation, and blended creation, which were 5919.0 yuan, 3074.7 yuan, and 1387.8 yuan, respectively.

It can be seen that the average cost of creating characters, the average cost of creating scenes, and the average cost of blended creation were lower than those of traditional animation creation and AI creation.

4.3 Creative implementation

The creation of traditional animation requires animators to deeply consider the conception and expression of the visuals in order to create excellent works. However, the application of AI technology can help animators achieve creativity more quickly, allowing machines to learn and master painting skills in a short period of time, and generating more natural and vivid images. Through AI, scenes and characters can be intelligently matched, allowing for faster generation of excellent animation works. In addition, the addition of AI can better achieve diversified creativity.

350 audiences were selected to rate the creativity of different creative methods, as shown in Figure 2 (where the horizontal axis represents the type of creation, and the vertical axis represents the rating).

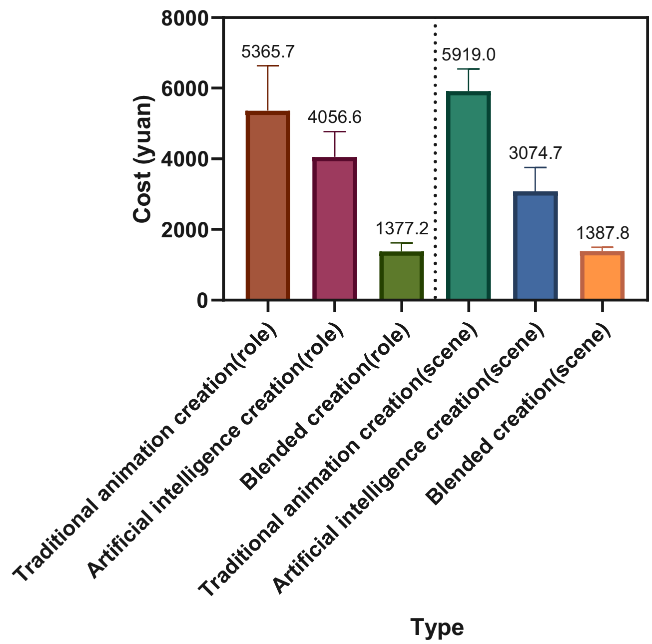

Figure 1: Average cost of creation using different methods.

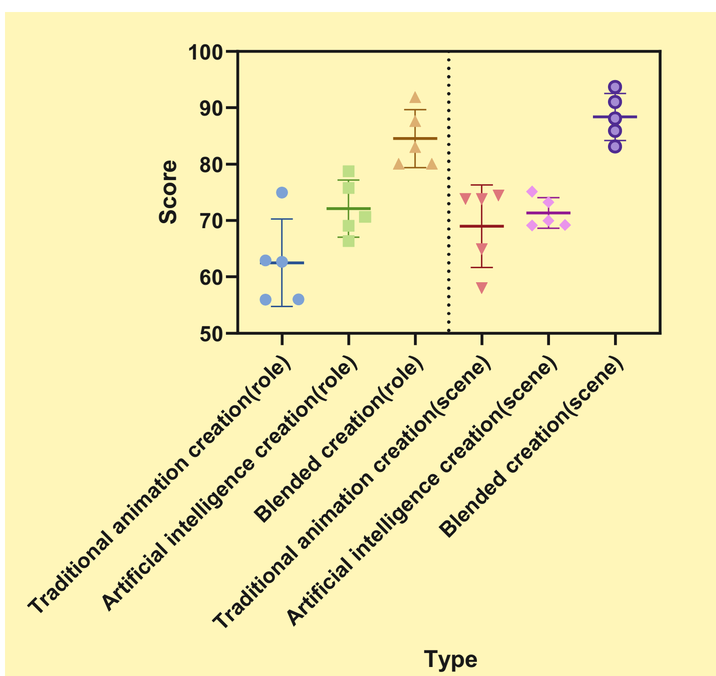

Figure 2: Creative ratings for different creative methods.

As shown in Figure 2, the left side of Figure 2 represents the average creative rating of the audience on characters through traditional animation creation, AI creation, and blended creation. The average creative rating of characters for traditional animation creation and AI creation was generally within 80 points, while the average creative rating of characters for blended creation was generally above 80 points. The right side of Figure 2 represents the average creative rating of the audience for scenes through traditional animation creation, AI creation, and blended creation. The average creative score for blended creation scenes was also above 80 points overall.

The average creative rating of the audience for characters and scenes through blended creation was generally above 80 points, which was higher than the average creative rating of characters and scenes through traditional animation creation and AI creation.

Blended creation possesses the cognitive ability of the human brain and the perceptual ability of the body, distinguishing human emotions from speech, generating tactile, auditory, visual, and other senses, and providing feedback on these emotions or feelings. These feedbacks become memories similar to the emotional experiences of creators in AI, thus creating works with "uniqueness" similar to the creator's creations.

4.4 Attracting audiences

With the rapid development of modern technological society and economy, people's quality of life is getting higher and higher, and their aesthetic requirements for art are gradually increasing. It is not only necessary to have comfortable art display methods, but also to participate in the interaction of art works through technology. Among numerous technological means, AI technology is currently the most widely applied and widely accepted field of intelligent technology. Whether it is in the fields of film and television, art, or news communication, the presence of AI has been integrated, which is also an inevitable trend in the development of contemporary interactive art.

The number of audiences attracted by different methods of character creation is shown in Table 3.

Table 3: Number of audiences attracted by different methods of character creation (10,000 people)

Type and average	Traditional animation creation	AI creation	Blended creation
Film	2.52	5.13	6.56
Advertisement	3.79	5.49	7.55
Game	2.71	5.42	7.42
Entertainment	3.65	5.50	7.43
Teaching animation	3.32	5.24	6.59
Average	3.20	5.36	7.11

As shown in Table 3, the average number of audiences attracted by characters through traditional animation creation, AI creation, and blended creation was 32,000, 53,600, and 71,100, respectively. Among them, the average audience attracted by characters through blended creation was the highest, which was 122.2% $\left(\frac{7.11-3.20}{3.20}=122.2\%\right)$ more than the average audience attracted by characters through traditional animation creation, and 32.6% $\left(\frac{7.11-5.36}{5.36}=32.6\%\right)$ more than the average audience attracted by characters through AI creation.

The number of audiences attracted by different methods of creating scenes is shown in Table 4.

As shown in Table 4, the average number of audiences attracted by scenes of traditional animation creation, AI creation, and blended creation was 24,900, 29,800, and 46,300, respectively. Among them, scenes through blended creation attracted the highest average number of audiences.

Blended creation helps improve the personalization and interactivity of animation content, generating more personalized content based on audience preferences and habits, providing a more personalized user experience, and attracting more audiences than traditional animation and AI creations.

Table 4: Number of audiences attracted by different methods of creating scenes (10,000 people)

Type and average	Traditional animation creation	AI creation	Blended creation
Film	2.63	2.71	3.57
Advertisement	2.79	3.70	4.34
Game	2.18	3.37	5.65
Entertainment	2.34	2.53	4.09
Teaching animation	2.53	2.61	5.52
Average	2.49	2.98	4.63

4.5 Promoting the economic development of the animation industry

With the development of human society and the rapid development of the digital information age, people's lives have become rich and diverse, and their pursuit of beauty has continuously increased. The expression of art is becoming more and more free from simple painting forms, which has prompted creators to use diverse expression techniques to create. The final artistic creation, compared to the past, focuses more on aesthetics and emphasizes the intervention of ideas and cultural connotations, allowing emerging concepts to spread and break free from the constraints of old ideas, allowing them to stand still with new forms of art.

The income generated by different methods of creation is shown in Figure 3 (the horizontal axis in Figure 3 represents the type of art, and the vertical axis represents the income, in units of ten thousand yuan).

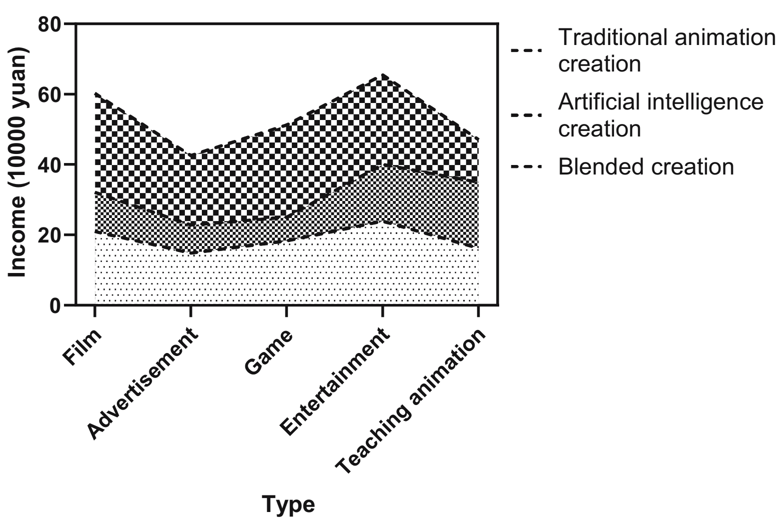

Figure 3: Income from different creative methods.

Among them, the dark dot-shaped description displays blended creations; the light gray area in the middle displays AI creations; the light white dot-shaped part is traditional animation creations. From Figure 3, it can be seen that the highest income brought by blended creation exceeded 600,000 yuan, while traditional animation and AI creation were also within 600,000 yuan.

The income brought by blended creation was higher than that brought by traditional animation creation and AI creation, indicating that people were more concerned about blended creation of animation works.

Through blended creation, creators can create more flexibly and explore different artistic styles and animation forms. Blended creation changes the traditional animation style, increasing the sense of visual hierarchy and effects, providing creators with more possibilities, and attracting more audiences. The combination of AI and traditional animation technology has promoted innovation and international exchanges in the animation industry. By applying AI technology to animation creation, the animation industry of various countries can learn from and exchange with each other, promote the development of the global animation market, and increase the competitiveness of the animation industry in the international market.

5 Discussion

Figure 1 shows that blended creation can significantly reduce costs. By incorporating AI technology, traditional animation production can achieve automation and semiautomation, allowing machines to perform more repetitive work, thereby reducing the workload of animation creators. For example, some animation scenes and characters can be generated by machines, reducing the workload of animation creators while ensuring the quality of the images.

The cost of traditional animation creation is relatively high. The biggest bottleneck of applying traditional methods to animation creation is the high cost of production and modification. It is difficult to adjust the production process after the early stage is completed, and the final image effect can only be seen after rendering and post-synthesis. Such a low efficiency creative mode is not conducive to the innovation of animation content and the iteration of creativity, nor is it conducive to the stylistic creation of the integration of 2D and 3D animation. The foundation of using Unreal Engine to create animation lies in its one-stop creation mode. While building a standardized system for engine animation, the creative dimension is increased and the production dimension is reduced, ultimately delivering the time for modification and rework to the creative content itself.

Table 4 shows that current blended creation can reduce time-consuming and labor-intensive labor. Through this combination of form and meaning, creators can act as observers of the art scene and also allow visitors to witness the process of producing art together.

In the current era where the display and interactive dissemination of art are becoming increasingly diverse, and the expression of artistic works is becoming more diverse, creators are beginning to try to break away from fixed traditional thinking patterns and emphasize the importance of new media, computer computing, imaging, and work time efficiency in their creations. As creators continue to innovate and improve, AI makes aesthetic expectations increasingly uncertain.

6 Conclusions

In the era of AI, due to its huge storage capacity and extremely fast computing speed, its knowledge reserves can be very rich, and the styles and styles of its created paintings far exceed people's imagination. AI has long had the ability to completely replicate artworks. Human art has lost its original authenticity, which means that people are no longer focused on exploring the uniqueness of artistic works, and art has taken on new meanings. The integration effect of AI technology and traditional animation creation technology is very significant. By combining AI technology with traditional animation creation techniques, the efficiency and accuracy of animation production can be improved, while ensuring the creativity and artistic value of animation. In the future, the application of AI technology in traditional animation production would become increasingly widespread, and it is expected to become a powerful tool for animation production.

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