Study on the Design Method of Cartoon Character Modeling Based on Evolutionary Computation

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Abstract: The animation industry is in a relatively advanced development state among emerging industries in China. Due to the excellent expression of anime character images and their ability to fully express the theme ideas through language, expressions, music, and other means, they have received good evaluations. However, in 3D anime design, the aesthetics and quality of cartoon character designs will directly affect the artistic expression of the work. Therefore, this article first outlines the background of cartoon character design in anime, and on this basis, proposes the use of evolutionary calculus methods to design the evolutionary generation and styling of cartoon character components. Through experiments, it has been shown that the method of evolutionary computation is beneficial for improving the design speed of cartoon character designs and greatly reducing the workload of designers.

Keywords: evolutionary calculus; Cartoon characters; Styling design; Method research.

1. Research background:

1.1 Literature review

The animation industry, as a technology intensive industry, is also an intellectual industry with high capital and added value. At the same time, it has the characteristics of visual entertainment as the main content, values as the main connotation, high investment return rate, and wide audience range (Bezbaruah N, Brunt A, 2012). At present, many scholars have started related research. The Japanese anime industry, with its excellent storytelling, vivid anime images, and advanced imaging technology, has attracted the attention of the world, occupying two-thirds of the relevant market share. Its export output value even exceeds that of domestic industrial products such as steel, and has a chain effect on the economy (Xiang L, Xu J, Weidong A G, 2011). Using creativity as a resource to achieve minimal energy consumption, not only meets the growing cultural and entertainment needs of the country's people, but also enhances the development of the country's soft power. The animation industry in Japan has completed the appreciation of intangible assets in the "lost decade" and can draw inspiration from it (Wilson P D, Shaw N C, 2010). Especially the development scale and degree of the animation and creative industry have become important indicators of the country's comprehensive competitiveness. Some scholars explore the new structure of network structure from the perspective of industrial chain structure, and summarize the implementation mode of industrial chain value form and knowledge form. Propose an animation entrepreneurship industry cluster to cultivate complementary assets for local enterprises.

The above literature has analyzed the significance of cartoon characters in anime from multiple perspectives, but has not explored the design of cartoon character shapes through evolutionary computation. Therefore, this article will analyze and design relevant character images from this perspective.

1.2 Research purpose

How to present cartoon character designs in the most delicate way is a current academic concern and the focus of this article. Generally speaking, through the use of multi emotional interactive forms of expression, anime can deeply express the main idea and be loved by teenagers. At the same time, it is of great significance for promoting cultural and economic growth, and has good development prospects. Among them, designing cartoon character designs is the best way to express such issues. However, in the production process, the aesthetic appearance of 3D anime has a significant impact on the work. Therefore, using evolutionary computing methods to complete it has great reference value.

2. Theoretical Analysis of the Background and Evolutionary Calculus of Anime Cartoon Character Design

2.1 Background of Anime Cartoon Character Design

The animation industry is an industry that uses animation or images as a form of expression, based on current information technology for creative design, research and development, publishing, and sales of animation products, as well as the production and operation of derivatives related to animation. With the upgrading of computer graphics technology and internet technology, 3D animation has become a new form of artistic existence (Lemenager S, 2012). Based on the anticipated design scheme and scene, according to the movement route of the characters and the movement trajectory of the camera; And other animation parameters, after setting specific materials and lighting for the model, specific designs are carried out (Jong K D, 2010). In recent years, with the support of national industrial policies and the rapid development of animation enterprises, China's animation industry has entered a stage of rapid development. Mainly reflected in significant improvement in economic benefits and sustained growth in market size. In addition, local governments have implemented supportive policies and achieved good returns. As of the first half of 2018, the output value of China's animation industry reached 78.6 billion yuan, a year-on-year increase of 20.1%.

Currently, compared to 2D animation, 3D animation has more artistic expression and more realistic visuals. Through anime modeling,

one can use imagination and computer software to draw the shapes of cartoon characters. The inspiration and artistic influence of modeling design are more significant (Xue B, Zhang M, Browne W N, et al, 2016). For example, in the American anime "Ratatouille", 3DMAX was used in advance to design cartoon character shapes, which were then imported into the anime scene and rendered accordingly. This method requires a high level of artistic aesthetics from designers, and the process is time-consuming, resulting in a large amount of repetitive work.

2.2 The relevant theories of evolutionary calculus

Evolutionary calculus is a method of simulating a population for evolutionary sequencing and randomly solving problems. It is generated by simulating the process of survival of the fittest in the biological world, and gradually stabilizes through the cross mutation of biological genes, forming a variety of diverse populations (Doerr B, Happ E, Klein C, 2012). Inspired by this, a new computational method called evolutionary computation is gradually proposed, which uses simple encoding to represent various complex real-world problems, and filters through simple genetic algorithms. Ultimately, it serves as a new computational tool to guide learning and exploration directions. Evolutionary calculus involves knowledge systems, information processing, combinatorial explosion, and proposes a universal solution mechanism based on this.

3. The Evolutionary Generation and Styling Design of Cartoon Character Components

3.1 The Evolutionary Generation of Cartoon Character Components

The use of cross genetic algorithm involves applying binary tree coding to the body structure of cartoon characters and evolving them into new images. Using the generated construction as the source of the structure can improve the convergence phenomenon of this algorithm in searching for tacit understanding. Based on this, this paper proposes an interactive genetic algorithm for the evolutionary generation of cartoon character construction (Jin Y, 2011).

Design necessary styling components for cartoon characters in Maya and import them into the system database. At the same time, extract the required builds from the database and use them as templates for the components. At this point, new components can be generated through ACIS non-uniform scaling. The so-called ACIS API has powerful functions for three-dimensional cartoon character modeling operations, and is used to write binary tree form rule strings according to certain rules. By evolutionary coding, different stages of scaling and deformation of cartoon character components can be achieved. Provide more diverse materials for the overall design of characters. At this point, appropriate ACIS technology plays a crucial role in constructing the image of cartoon characters.

Unlike real number encoding, binary tree encoding is more flexible in expression, as shown in Figures 1 and 2: the former represents the two binary trees before crossing, while the latter represents the two binary trees after crossing. It can be seen from this that the crossover operation of the binary tree is relatively random, and a node is selected from it, so that each subsequent node will have a corresponding node generated.

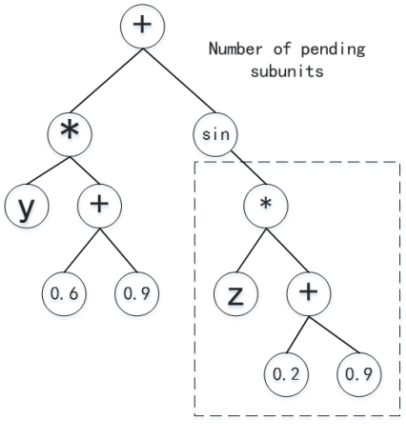

Fig.1 Number of pending subunits

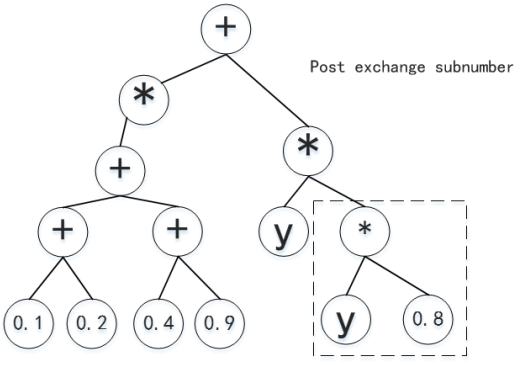

Fig.2 Post exchange sub number

3.2 RIBIGA performance testing analysis

In this section, evolutionary generation algorithm is used to design specific RIBIGA parameters for cartoon character modeling components, as well as comparative experiments with IGA,

Table 1: parameter settings

Parameter Type	Value
Population size N	55
Crossover probability	0.47
Variation probability	non-isolated: 0.054; isolation; 0.041
Population model conversion reference value	0.0247

Table 2: performance comparison evaluation

Evaluation index	RIBIGA	IGA		
		Pro.1	Pro.2	Pro.3
Evolutionary time	254	221	241	253
Average score	5.7	5.2	4.2	5.4
Final satisfaction score	6.8	6.5	5.7	6.3

From the data in Tables 1 and 2, it can be seen that the average score of RIBIGA is higher than that of IGA. Here, under the method of evolutionary computation, the RIBIGA algorithm can better meet the aesthetic requirements of users. By collaborating with experts to score, the impact of subjective evaluation results can be reduced, and the non-uniform scaling of parameter population evolution for binary trees can result in different types of cartoon character shapes.

3.3 Cartoon style assembly design

After obtaining sufficient cartoon character components, proceed with the next assembly work on these components. Given that the assembly of cartoon characters requires a certain degree of partial order, the head should be fixed and other parts of the body should be set, with arms and legs corresponding to their respective positions.

3.4 Analysis of experimental results

By adopting a new approach of evolutionary computation and adding random perturbation methods, the optimal performance of the algorithm in the development phase is accelerated, thereby improving the overall accuracy of the algorithm. By improving the convergence speed of the algorithm, the design of cartoon character shapes can be optimized. Based on this, this algorithm can be used to achieve human-computer interaction and ultimately accelerate the computational speed of cartoon character design.

4. Conclusion

In summary, cartoon character design has become the most important task for many designers at this stage. Expanding new design ideas is a key point in cartoon character design. This article proposes the use of an improved interactive genetic algorithm to apply binary trees to the body components of cartoon character modeling, and to produce a database composed of batch components. At the same time, different network topologies were set up based on the architecture of the coevolutionary server and scoring system to achieve the final collaborative design. In response to the physical deformation of cartoon character designs, the diversity of styles is increased through component evolution, making cartoon characters more diverse. Therefore, this new design method has significant advantages, as it can quickly generate ideal cartoon character shapes in a very short time, effectively reducing the workload of designers.

Reference:

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