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Computer-Aided Design AND APPLICATIONS

Digital Asset Management Tool for Film Animation and Game Development

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Abstract. With the continuous development of China's economy and technology, China's market has also produced a large number of excellent film and television works with beautiful pictures. Once launched, it has been loved by consumers and promoted the further development of China's economy. Through research, it is found that this has a great relationship with the application of game engine to the design of film and television animation. This paper discusses the design and implementation of video animation of game engine. This paper uses the CAD game engine to create an animation example "Pipi's Creation" to illustrate the whole process of using the game engine to create film and television animation. In the process of creation, it focuses on describing the different processes of video animation produced by game engine and traditional animation, as well as the different links in the creation, and completes the creation of examples. Based on the above research, on the basis of 3D software CAD, a digital asset management system for computer-aided video animation and game development has been developed and implemented.

Keywords: CAD; Film and Television Animation; Game Development; Digital Asset Management.
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1 INTRODUCTION

The research of computer-aided tooling design is basically carried out simultaneously with CAD technology. In the field of mold, foreign countries began the research of mold CAD/CAM in the 1960s and put it into production in the early 1970s. For example, the United States Diecomp Company successfully developed the PDDC system for computer-aided design of progressive dies in 1973 [1]. The research and implementation of the knowledge-based stamping die CAD system

of the system was put into use, which shortened the design cycle of continuous dies from 8 weeks to 2 weeks from manual design, and the entire production preparation time from 18 weeks to 6 weeks, thus enhancing the company's competitiveness [2]. The research of CAD/CAM for automobile panel dies has achieved success in all major automobile companies in the world. Among them, Japan Toyo Automobile Co., Ltd. adopted the CAD/CAM system for dies in 1980, which can reduce the design and processing time of panel forming dies by 50%. General Motors Corporation of the United States, Ford Motor Corporation and PSF Corporation of the United Kingdom have all established the CAD/CAM system of the panel drawing forming die, especially Ford Motor Corporation has made great achievements in the plastic forming die of the panel [3].

However, due to the limitations of traditional concepts and technological innovation, although domestic animation has made great progress in the past two years, there are still some problems such as a small number, monotonous types of varieties, and too concentrated themes. At the same time, due to the problems of outdated concepts, rough production, and single technique, China has fewer original animation works with independent intellectual property rights, and the works lack artistic attraction and market competitiveness [4].

The developers of film and television animation are only concerned about how to create as many new works as possible and sell them to the audience. Although the current film and television animation creation is mostly simple and rough, the average development cycle of each work should also reach more than 8-10 months. The monthly 3D animation production of D5 Studio, a famous professional 3D animation production company in China, is only 50 minutes. On the one hand, it is due to technical reasons, on the other hand, it is because every work has to be created from scratch, character design, etc., resulting in a lot of repetitive work. With the powerful function of the game engine, a new technology - engine film, as a new tool for international film and television production, is gradually approaching people's vision and attracting more people to study [5].

Based on the research of traditional animation creation, this paper inherits the creativity of topic selection, animation modeling, structural story, narrative, imagination, and aesthetic taste of traditional animation, and tries to use the advantages of game engine to explore the production process, production process, and application of digital technology of computer animation by learning the construction mechanism of CAD game engine, Explore useful experience for batch creation of domestic 3D animation.

2 STATE OF THE ART

As a comprehensive application of a number of digital management technologies, the digital transformation of film and television animation enterprises' erp will show significant integration characteristics. The enterprise erp metauniverse will access more different film and television animation industries, and the film and television animation industry will become an important part of the film and television animation metauniverse. Realize the digitalization transformation of enterprise erp with the digital management of metauniverse. Lin [6] believes that the new digital transformation economic form of the in-depth integration of the film and television animation enterprises' erp economy has the characteristics of always online, complete operation and high-frequency occurrence. Due to the comprehensive integration of visual simulation factors, information transmission is promoted from two-dimensional plane to three-dimensional space. In the future, the erp content output form of film and television animation enterprises will be more vivid and flexible, which will effectively enhance the user's sense of reality, presence and immersion. This has greatly expanded and enriched the content system of film and television animation. Ma [7] believes that when implementing the erp of film and television animation enterprises, the company group needs to gradually iterate online to use a variety of different financial investment portfolio and film and television animation information technology according to its actual needs. Including digital management business intelligence BI, treasury fund management historical data back test, treasury fund management Monte Carlo simulation, stress

test, etc. At the same time, it is necessary to monitor the design and simulation system of fluid dynamics of capital liquidity and the control system of the universe fluid pipeline of capital liquidity. Rong [8] uses computer multimedia and database technology to build an Animation Appreciation Assistance System (AACAS), which classifies classic animation works by type, classifies the key points of appreciation, defines attributes. Shuo [9] analyzed the scale and budget range required by film and television animation companies to achieve digital transformation and digital management. Determine the scope planning of applicable corporate financial instruments and film and television animation technology. Zhao et al. [10] discussed two basic indicators, namely skills and style, the most advanced depth RL model cannot be transferred seamlessly from the baseline environment to the target environment without seriously adjusting its parameters. This results in linear scaling of engineering work, and the calculation cost is proportional to the number of target domains.

In a word, the ultimate purpose of developing CAD/CAM software is to apply CAD/CAM technology to improve the design and manufacturing level of enterprises. Therefore, CAD/CAM software should not only be of high level and have its own characteristics, but also be able to be market-oriented and recover investment from the market, so as to continuously update and develop software according to the needs of users.

3 METHODOLOGY

3.1 Implementation Framework of Animation Development Based on CAD

Any motion of movie and television animation objects cannot leave the motion track. Before designing 3D film and television animation, we need to determine the motion trajectory. Given the motion trajectory of the object, we can control the motion direction and form of the object. Each object in a 3D solid is stored in a computer in the form of 3D data. The motion track of its film and television animation is also determined by 3D data inside the computer. That is, first establish the 3D data (initial data) of the entity and scene in the computer, then set the 3D data of the motion track and action, and finally generate the animation after rendering and display. So before generating animation, you need to determine the motion trajectory of 3D solid objects. The motion trajectory of modeling animation cannot be arbitrarily specified, and must conform to certain physical laws. Three-dimensional solid is considered as a rigid body here, and deformation such as stretching, compression and twisting cannot occur during the movement. According to the characteristics of 3D solid, the animation motion path planning in 3D solid modeling animation system can be divided into two types: one is the motion path independent of assembly constraint relationship; The other is motion trajectory based on assembly constraint relationship.

This motion trajectory is applicable to all 3D solid models, that is, to parts and assemblies. When determining the trajectory, the 3D solid model is regarded as a whole without considering its assembly characteristics, and the motion is independent of the assembly constraint relationship between parts. You can arbitrarily determine the motion trajectory of the solid for translation and rotation in 3D space as needed.

Quantitative constraints represent a kind of fit between shapes. Of course, quantitative constraints also imply qualitative constraints. For example, the distance between faces and faces must first require two planes to be parallel. This parallel constraint is a qualitative constraint.

The quantity of quantitative constraints can be changed. Qualitative constraints include the following: coplanar, reverse coplanar, collinear, coplanar, in-plane, point-on-line, and point-on-plane. Each constraint links two or more geometric elements together, so the geometric elements need to be mathematically expressed. Geometric elements mainly include points, lines, planes, quadric surfaces, direction vectors, etc. Points are the most basic elements. Elements are expressed in x, y, and z coordinates, lines are expressed in base points and direction vectors (b and), planes are expressed in base points and plane normal vectors (b and no), and quadric surfaces are expressed in base points, direction vectors, heights, and radii (b, d, h, rl, r2).

As shown in Figure 1, form (c) is a combined form formed by form (a) and (b) after position transformation (M, M2) and operation respectively. Form (a) can be regarded as the basis of form (b), so M, is the unit matrix. Now the problem is how to transform form (b) from its local coordinate system to the global coordinate system of form (c) and make it meet the dimension requirements, that is, calculate the matrix M2 so that:

$$l_{a1} - M_2 l_{b1} = D_1 \tag{1}$$

$$l_{a2} - M_2 l_{b2} = D_2 \tag{2}$$

This description transforms the linguistic and graphical constraints into the mathematical constraint of solving the transformation matrix. A shape may contain multiple or multiple constraints, and only when all of these constraints are met can the correctness of the shape be guaranteed. The general expression of all constraints in a shape is:

$$\sum_{i,\ j=0}^{m} \sum_{k=0}^{n} M_i e_{i,\ k} - M_j e_{j,\ k} \tag{3}$$

Where i ≠ j, i, j is the number of sub-bodies contained in the combined body; K is the number of constraints between i and j, "-" represents the amount of constraint violation, and e represents the element of constraint.

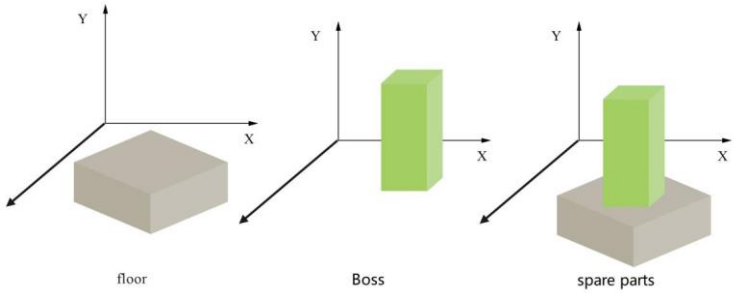

Figure 1: Schematic diagram of shape combination.

Figure 1 shows a shape combination diagram. The JHSolid system based on Visual C++development platform uses object-oriented methods in the whole design process, from analysis to design to programming. When designing and developing 3D animation functions in the JHSolid system, we need to analyze the functional requirements of animation functions. Analyze what operations the software system needs to perform to support this requirement, and design the objects of these operations. For the animation part, which needs to realize the functions of rotation animation, explosion animation and explosion animation release, the analysis system needs to create the following classes to realize the animation tools: interface object class: this class is designed to meet the interaction between the system and the outside world. For example, interact with the user (or input device) to obtain the required data, or interact with the output device to output the calculation results to the external world. In the JHSolid system, this classification is mainly designed into dialog box class, toolbar class and menu class. Figure 2 shows the overall implementation block diagram of video animation and game system.

3.2 Implementation of Rotating Animation in Film, Television and Game Development

The purpose of rotation animation design is to enable the 3D CAD system JHSolid to generate omni-directional rotation animation, and to playback the animation or display a specific frame as required after the animation is generated, that is, to realize dynamic playback and single frame

display of the animation. The omni-directional rotation animation can dynamically display the structure of the entity, and designers and users can clearly and intuitively see the status of each part of the entity.

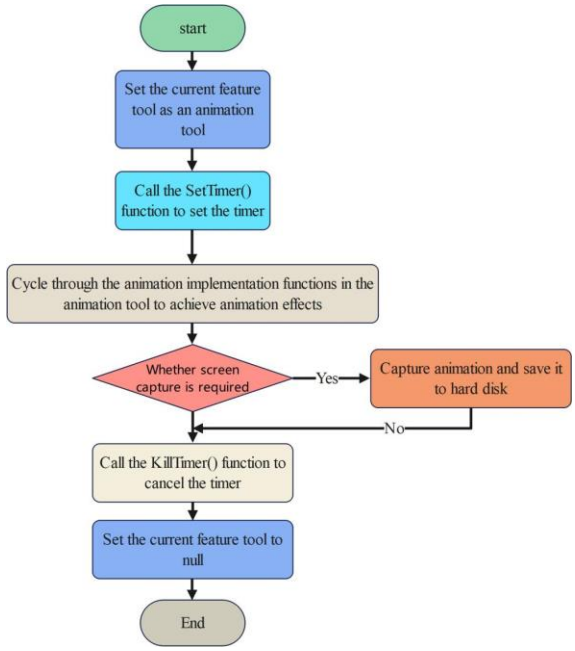

Figure 2: Overall implementation block diagram of video animation and game system.

According to the principle of graphics 4), in the right-handed coordinate system, the relative coordinate origin rotates around the coordinate axis θ The transformation formula of angle is:

Rotate around the x-axis:

$$\left[*y^{*}\ z^{*}\ 1\right]=\left[xyz1\right]\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & \cos\theta & \sin\theta & 0\\ 0 & -\sin\theta & \cos\theta & 0\\ 0 & 0 & 0 & 1\end{bmatrix} \tag{4}$$

Rotation about y-axis:

$$\left[*y^{*}\ z^{*}\ 1\right]=\left[xyz1\right]\begin{bmatrix}\cos\theta & 0 & 0 & -\sin\theta\\ 0 & 1 & 0 & 0\\ \sin\theta & 0 & \cos\theta & 0\\ 0 & 0 & 0 & 1\end{bmatrix} \tag{5}$$

Rotation about z-axis:

$$\left[*y^{*}\ z^{*}\ 1\right]=\left[xyz1\right]\begin{bmatrix}\cos\theta & \sin\theta & 0 & 0\\ -\sin\theta & \cos\theta & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\end{bmatrix}. \tag{6}$$

The essence of OpenGL transformation is to multiply the transformation matrix M by the current matrix C to make C=CM, thus changing the value of the current matrix. Realize the changes of entities in the scene. In OpenGL programming, it is very simple to realize the rotation motion of an entity by calling the function Void glRotate {fd} (angle, x, y, z). In this function, the first parameter is the rotation angle, and the last three parameters indicate whether to rotate around the axis. Calling this rotation function essentially multiplies the current matrix by the rotation transformation matrix, and assigns it to the current matrix, so that the 3D entity rotates

follows:(1) Select K clustering centers as the clustering centers v1, v2, v3 of the K-means clustering algorithm iteration of the digital asset sample of the digital asset management system of colleges and universities vn(2) For the digital asset sample X of digital asset management system for film and television animation and game development (set to the K th iteration), if:

$$\left|X-v_{j}^{k}\right|<\left|X-v_{i}^{k}\right| \tag{7}$$

Then Sjk is a sample set centered on vjk.

(3) Calculate the new vector value of each cluster center of the digital asset sample of the digital asset management system developed by film and television animation and games:

$$v_{j}^{k+1}=\frac{1}{n_{j}}\sum_{X\in S_{j}^{k}}X,(j=1,2,\ldots,k) \tag{8}$$

(4) If: (9) Return to the second step, re-classify and re-iteration the digital asset samples of the digital asset management system of all colleges and universities;

$$\sum_{i,\ j=0}^{m}\sum_{k=0}^{n}M_{i}e_{i,\ k}-M_{j}e_{j,\ k}\ l_{a2}-M_{2}l_{b2}=D_{2} \tag{9}$$

If:

$$v_{j}^{k+1}=v_{j}^{k},(j=1,2,\ldots,k) \tag{10}$$

it ends.

Calculate the distance from each data point to the cluster center:

$$d_{ij}^{(t)}=X_{j}-C_{i}^{(t-1)}{}_{;\,i}=1,\ldots K \tag{11}$$

Calculate which cluster the data points belong to (membership matrix):

$$w_{ji}=\begin{cases}1,\arg\min\limits_{i=1}^{K}\left\{d_{ji}^{(t)}\right\}\\ 0,\ \text{otherwise}\end{cases} \tag{12}$$

Update cluster center:

$$C_{i}^{t}=\sum_{j=1}^{N}w_{ji}^{(t)}X_{j}\ /\ \sum_{j=1}^{N}w_{ji}^{(t)};i=1,\ldots K \tag{13}$$

According to a certain similarity criterion, the digital assets of a digital asset management system developed by a film and television animation and a game are classified into points, namely, digital asset segmentation. The advantages of fuzzy clustering digital asset segmentation are intuitive and easy to implement. The disadvantages of multimedia C-means fuzzy clustering processing in digital asset management system are: large amount of computation and long computer time.

The classification result is represented by a fuzzy membership matrix U={u; k} ∈ Rn, which must meet the following requirements:

$$\begin{cases} u_{ik} \in \{0,1\}, 0 < i \le c, 0 \le k \le n \\ \sum_i u_{ik} = 1, 0 \le k \le n \\ 0 < \sum_k u_{ik} < n, 0 < i \le c \end{cases} \tag{14}$$

By minimizing the objective function Jm (U, V) of the membership matrix U and the cluster center V:

$$J_M(U,V) = \sum_{k=1}^{n} \sum_{i=1}^{c} (u_{ik})^m \, d_{ik}^2 \, (x_k, v_i) \tag{15}$$

By analyzing and comparing JAVA with other mainstream development systems, in order to improve the efficiency of system development and design, and also to reduce the cost as much as possible, the government document circulation management system decided to adopt J2EE system for development.

4 RESULT ANALYSIS AND DISCUSSION

4.1 Development Process of Film and Television Animation and Games Based on CAD

The specific production process of the game engine using CAD is the medium-term production process of the film and television animation production. It is based on the preliminary planning, according to the content of the software requirements, the role modeling, 3D scene (level) production, lighting, camera setting, animation, skeleton and skin, editing script sequence, etc. Through research, it is found that in game development, the traditional market mainly focuses on the computer ability of developers, as shown in Figure 3, but does not pay attention to the application ability of CAD.

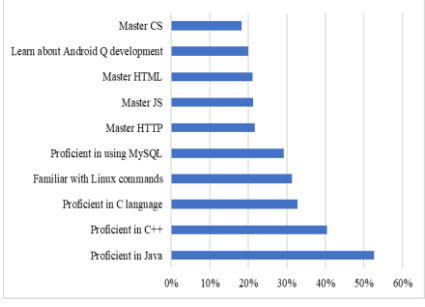

Figure 3: Key capability points of traditional game development.

In character modeling, polygons use subdivision surface technology, patches use Surface Tools technology, and NURBS use its own surface tools to independently complete the production requirements. The whole character production process is: body, arm, palm_ Leg - neck - head - eye - nose - ear - mouth - other parts of the head (eyebrows, tongue, teeth, hair, etc.) - clothing (shoes, socks, clothes, pants, etc.). Limited by space, this article will not introduce in detail. Firstly, the process information of machining objects related to die design is obtained from stamping parts and environment. Then the system automatically judges the overall structure of the mold base and determines the mold type according to this feature information and a series of mold design rules and experience in the knowledge base. Then, we will retrieve similar instances.

4.2 Result Analysis

Select different parts and follow the above steps to add textures for different parts. After adding, click to return to the original layer. Because the default setting of CAD view is to display only one wireframe instead of texture display image, texture is not displayed in CAD view. For different animation parts, the clustering algorithm is used to identify the digital asset management capabilities of different parts. The identification results are shown in Figure 4. It can be seen from the figure that the clustering distance between sample numbers 27-11 is relatively large, which also shows that the use of CAD is effective for digital asset management systems in film and television animation and game development.

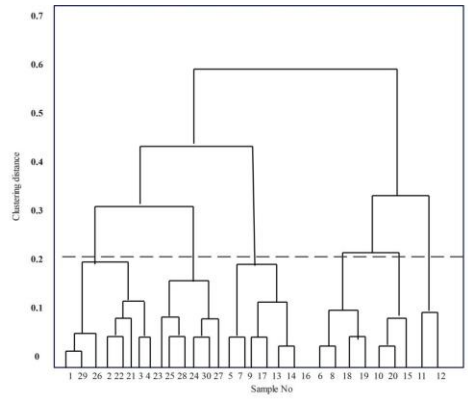

Figure 4: Digital asset management identification in animation development.

Understanding the object model of AutoCad is the basis for its programming. AutoCAD organizes objects in a hierarchical structure. The top layer is Application, and the bottom layer is Preferences, Document, etc. The Document object contains a series of objects such as ModalSpace, PaperSpace, Blocks, Layers, Plot, Utility, etc. The bottom objects are basic graphic objects such as points, lines, circles, and arcs. VBA can return AutoCAD objects and their methods and attributes through ActiveX Automation technology. The developed application controls the work of AutoCAD by operating the methods and attributes of AutoCAD objects at all levels. Some operations of objects can be realized through methods, while the collection or change of object state information is completed through attribute operations. Use CAD tools to model the characters in film and television animation and game development. Figure 5 tests the recognition accuracy of basic graphic objects such as points, lines, circles and arcs in the development process.

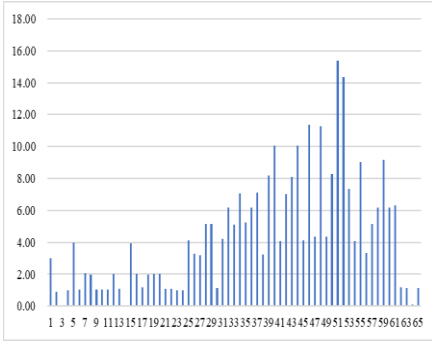

Figure 5: Recognition accuracy of basic graphic objects in CAD modeling.

Screen capture refers to recording the 3D solid animation process on the screen and storing it on the hard disk in AVI file format. 3D solid animation can vividly represent various information of 3D solid, such as the shape of 3D solid, relative position relationship, assembly constraint relationship, etc. Recording the animation can record the information in a very vivid form. Figure 6 shows the response time of AVI video animation before and after CAD modeling. It can be seen from the figure that the response time of video animation after CAD modeling and character modeling in game development is significantly shorter than that of non-CAD modeling.

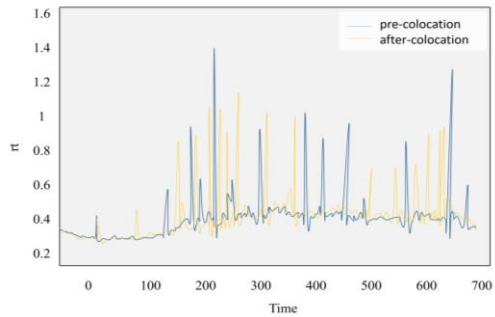

Figure 6: Video response time before and after CAD modeling.

In the whole film and television animation production process, the plot flow is composed of functions and physical actions. However, all physical motions, including the motion of characters and cameras, and the triggering of actions are controlled by script sequences. In the animation of Pipi's Creation, there are mainly the following events: first, the main event. It is responsible for the control of the whole script process, display setting control, camera conversion control, etc., which is automatically loaded by the game engine at the beginning and automatically run according to the time. The second is the plot event. It mainly includes Pi Pi playing with children, Pi Pi talking with grandpa, Pi Pi drawing with paintbrush, Pi Pi lifting the words box, etc. Third, subsidiary time. Including door opening and window opening events. Finally, the production of animation is the switching process between camera animation and events. The camera animation consists of three parts: a path curve generated by multiple path control points, an animated character associated with the path curve, and an entity that performs actions along the path curve. In this way, the engine will directly run the main script and call each script to manipulate the camera to move to generate animation, and finally form a complete animation process. Based

on the animation "The Creation of Pipi", the simulation results of the character "Pipi" are compared. The experimental results are shown in Figure 7. It can be seen from the figure that after using CAD modeling, the authenticity of animated characters is relatively higher.

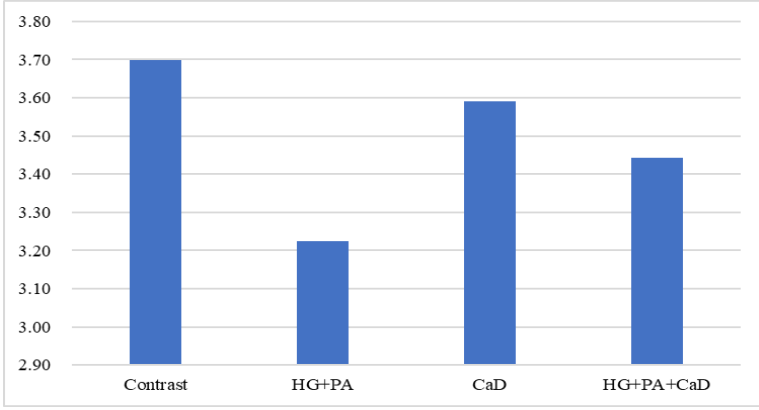

Figure 7: Authenticity of figures after CAD modeling.

5 CONCLUSION

The traditional film and television animation production method not only takes a long time, but also produces a relatively rough picture texture, which makes the traditional film and television animation production method increasingly unable to meet the requirements of economic development and technological progress. In this context, CAD, a new technology and relatively advanced tool for film and television animation production, emerged at the historic moment, largely solving the problem of low quality of film and television animation, meeting the people's high requirements for quality of life, and promoting economic and technological progress. This paper uses CAD technology to explore the film and television animation "Pipi's Creation" and the character modeling in game development. The result shows that the use of CAD technology can improve the accuracy of character recognition in film and television animation design and game development. Therefore, in the future production of film and television animation, production companies and designers should actively use game engines to produce film and television animation, and strive to satisfy consumers' audio-visual enjoyment, further stimulate consumption, and achieve the goal of promoting China's economic development and technological progress. At present, the concept of media asset management has been gradually established in China, but most of the relevant digital majors focus on artistic expression, content creation or industrial research and development, while the artistic production process management itself has not been emphasized too much. From the perspective of software positioning, Alienbrain's official definition is an asset management system for computer image and digital entertainment projects, which is mainly aimed at game development and 3D animation. Although more tools have provided us with more possibilities, for example, there is still no such system in the field of CAM and CAD, it is impossible and unnecessary for us to use a huge DAM system to put all the resources in it. We need to make full use of our strengths and avoid weaknesses and flexibly match them, and play a greater role.

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