

# Application of Augmented Reality Technology in Smart Cartoon Character Design and Visual Modeling

Shu Yang\*, Wei Lin

Wuhan Vocational College of Software and Engineering, Wuhan, Hubei, China, 430205  
Yangshuwuhan22@mail.com

**Abstract**—This paper designs and implements a cartoon character design and visual modeling system based on an augmented reality platform, allowing children to create a three-dimensional cartoon scene from their two-dimensional hand drawings and perform interactive operations in the augmented reality environment. In order to enhance the realistic visual experience in the virtual scene, modeling and behavior control of the characters in the 3D virtual animation design are carried out. Create a three-dimensional virtual animation character model in the POSER software, create a three-dimensional virtual animation character skeleton in the 3D software and skin the bones to realize the animation character modeling. The skeletal animation technology is used to simulate the movement behavior of the character, adjust the movement and drive the bones in the 3D software.

**Keywords**—*Augmented Reality, Cartoon Character, Visual Modeling, Character Design*

## I. INTRODUCTION

With the rapid development of network technology and computer graphics technology, virtual animation technology has become a research hotspot for scholars at home and abroad. Virtual animation technology belongs to a computer simulation system for experiencing virtual space. It provides users with virtual space by combining simulation technology, computer technology and microelectronics technology to enhance the user's sensory enjoyment and experience the immersive real feeling. 3dsMax technology software It is a kind of 3D animation software launched by an American company. It has a wide range of applications and is in a leading position in 3D animation production in the world. The 3dsMax technical software modeling function and 3D animation function are very powerful, especially in the production of 3D models, which is in a leading position in the world [1-6].

3dsMax technical software provides a wealth of modeling methods, which makes 3dsMax software have many modules with different functions, and different modules are different software, so it is more difficult and complicated to learn to operate this software. In addition, 3dsMax technology can be applied to many occasions. Due to the rich modeling methods of the software, various industries can use it to form three-dimensional models, from standard models to advanced models, allowing users to see as real and intuitive as the real world. , Which brings convenience to users. At present, this technology has been applied to more fields, such as entertainment games, virtual teaching, film and television

media, medical and tourism and other fields, and has gradually become an indispensable part of people's lives and work. The key part of virtual animation technology is to realize the roaming of the role model in the virtual scene, and to achieve this goal, the character modeling and behavior control in the virtual animation scene should be completed first. The abstract model used to simulate the internal geometric properties of the character model in the virtual animation scene is the three-dimensional character model. This type of model is saved by the computer in a special information format; behavior control is to control the action behavior of the three-dimensional character model in a specific way, so the virtual animation scene runs more smoothly [7-14].

This paper uses 3D character modeling to control the behavior of the model to improve the realistic and smooth effect of 3D virtual animation. Augmented reality (Augmented Reality, AR for short) is bringing changes to the world, even though it is currently only an emerging technology. A report issued by the investment bank Digi-Capita in 2015 believes that the AR market in five years will reach 120 billion U.S. dollars, which will change the fields of games, variety shows, medical care, education, online shopping, sports events, military, news, etc. m. At present, MagicLeap is the world's most watched augmented reality company, with a valuation of at least US\$4.5 billion. Google, Microsoft, Sony and other technology giants and investors are paying attention to the AR field. It is one of the research hotspots of many well-known technology companies, universities and research institutions at home and abroad in recent years. It represents the future of technology. Image cartoonization the third type of realization method is to use the material in the material library to match or replace the facial features of the face image to obtain the cartoon image [15-21].

For example, Liu Zhenan and others introduced the concept and definition method of generating SVG (scalable vector graphics) format face graphics component library and each component key node in the library, mainly discussing when components are combined and matched spontaneously, their corresponding coordinates are transformed. The final confirmation of the parameters, and finally the use of cartoon face graphics components stored in the gallery to automatically combine to obtain various facial expression graphics. C. Y. Yang et al. collected the contour information of each organ of the human face and stored it in the database. Analyze the face information of the input image, classify the face information, find the most matching organ shape in the library, and use the combination to generate the required face

portrait. Sketch-based modeling has always been a hot research field. This technique simplifies the traditional modeling pipeline, making modeling easier for children. Systems such as Teddy and its follow-up research, FiberMesh, ShapeShop, etc. perform modeling by allowing users to draw two-dimensional strokes from many different angles. There is also some research work focused on the rapid generation of pseudo 3D models rather than complete 3D models. In their work, Rivers et al. proposed a method to generate a 2.5D model by inputting multiple two-dimensional cartoon images. These 2.5D models can rotate freely in three-dimensional space, but they do not have a real grid structure. However, this system requires the user to draw a number of cartoon images from different angles in advance [22-24].

## II. THE PROPOSED METHODOLOGY

### A. Augmented Reality Technology

ARmp allows users to use the sophisticated 3D polygon modeling tools provided by 3ds Max to create models in an augmented reality environment. Air-Modeling provides a CAD (Computer Aided Design) interface that allows users to create virtual conceptual models in an augmented reality environment through some gestures. The modeling methods used in these systems are actually the same as those in traditional modeling tools, which is very difficult for children to master. Bergig et al. proposed a framework for constructing three-dimensional scenes in an augmented reality environment. This framework allows users to create common mechanical systems from some simple hand-drawn drawings. However, their system is only limited to some simple three-dimensional models and some specific attributes, which makes this system more suitable for certain specific application scenarios such as those related to mechanical systems. Augmented reality, English translated as augmented reality, referred to as AR in the industry.



Fig. 1. Augmented Reality Technology

It is based on a computer chip that captures the real scene and then calculates and generates information technology that superimposes or expands or enhances the real world. It integrates multiple disciplines such as computer vision graphics, light collection mapping, composite sensing, and digital imaging. Augmented reality technology is a supplement to the real world, making virtual objects a sensory part of the surrounding real environment. Mainly include image input equipment, user interaction technology, computer and storage equipment, tracking and positioning technology, virtual object database, virtual and real fusion technology, system display technology. It uses three-dimensional tracking and calibration technology, visual acquisition technology,

intelligent computing and hardware devices to allow virtual elements to "seamlessly" coexist with the real world and synchronize in real time, allowing people to experience virtual objects in real scenes and have real-time interaction. Broadly speaking, AR's enhancement of reality can be the sensory enhancement that integrates vision, hearing, smell, touch, sensory movement, GPS data and other aspects into a real environment displayed in real time. This technology integrates computer graphics technology, simulation technology, artificial intelligence, sensor technology, and network processing technology. It is a simulation system assisted by computer technology.

### B. Cartoon Character Design

In order to reduce the difficulty of character modeling, the more cumbersome steps in the modeling process are appropriately omitted. The existing character model can be used to create the required character model through modification, and the modified character model can be imported into the 3D virtual animation scene. For example, the POSER software designed by Franco is a common tool for creating models of three-dimensional characters. It can provide various types of character models, such as boys, girls, adult men and women, and puppets. Help, and the bones can be adjusted to the bone type required by the user through the toolbar in the software.

$$\rho_{out} = \sum_{m,n=0}^k e^{i\pi J} \times e^{-(\tau a^T a)} \quad (1)$$

$$\rho(t) = \sum_{n=0}^m \frac{(2\Gamma t)^n}{n!} e^{-(ta)^2} \quad (2)$$

The modeling steps of the virtual character in the 3D virtual animation design platform are as follows. To model 3D animation on 3dsMax technology software, we must first analyze the purpose of modeling, that is, the effect of the model to be created, so that we can better select the most suitable module on the 3dsMax software, and the operation will be more convenient. The specific application of 3D animation modeling technology on 3dsMax software mainly includes the following aspects. In cartoon hand drawings, outline pixels refer to pixels that are darker than their neighboring pixels. Since the saturation channel value contains the most visual sensitivity information, we first convert the input image from the RGB color space to the HSV color space.

The HSV color space refers to the color space composed of Hue, Saturation, and Value. It can describe more accurate perceptual color information than the RGB color space. After getting the cartoon image in HSV space, we then applied an adaptive binarization algorithm on the S saturation channel to get the binarized image. By entering a smaller threshold, we can convert the original image into a target image containing only two color values of 0 and 255 according to the following formula. Digital animation content is not limited to two- and three-dimensional animations, but can be experimental art, poster design, media promotion, industrial design, film and television special effects, multimedia technology, and architectural roaming. Therefore, the digital animation

discussed in this article mainly refers to the use of computer graphics and image processing technology, programming or animation software to generate a series of animation forms, not only limited to animated feature films, but also game animation, demonstration animation, Roaming animation, etc. Participation or interaction of works, reproducibility and editability, commercial entertainment of art, and virtuality of network communication are the core elements of digital animation art.

### C. Application of Augmented Reality Technology in Visual Modeling

The key technology of the 3D virtual animation design platform is the creation of the character model. The image characteristics and status of the character are displayed through the character model. Here, the POSER5.0 version is used for character modeling. Select the character body, face and hair models from the character model library that match the characters required by the 3D virtual animation design platform, stitch each model, and correct the original condition of the model through tools such as size reduction, splicing, and deletion. In order to obtain the required role model, it is necessary to modify the limited 3D resources in the POSER model library in the POSER software to lay the foundation for the subsequent role model skinning.

$$\delta_j^i = \beta_j^{l+1} (f(u_j^i)) \quad (3)$$

$$\frac{\partial E}{\partial b_j} = \sum_{u,v} (\delta_j^i)_{uv} \quad (4)$$

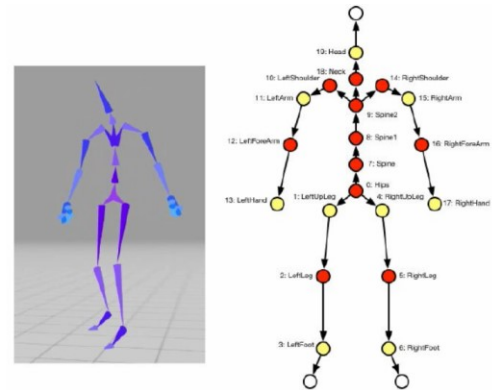
Export the adjusted character model in 3DMAX format and import it into the 3D software to continue the adjustment of the model. In order to make the model usable in special scenes, the character model created by the skinning tool plug-in should be modeled in the 3D software Unit adjustment. This model will be used in the VT software to perform reduction operations, so there is no need to reduce and adjust the model in advance. Since the role model is not exported in the format of textures, but exported through a skinning plug-in through a material format, the model cannot be directly exported in the form of textures in the 3D software, so two role models should be used in the design. They are a model of a character with clothes and hair, and a model of a face with a very clear face. In addition to simple interpolation animation, the model editing system also supports the addition of more complex character animations. Users can add character animation to a cartoon character model. For this, the user needs to place some specific bone nodes on the corresponding positions of the model, and then the system will automatically calculate the vertex weights for the model and play the skinning animation.

In order to deform a model, the system needs to calculate two kinds of data: bone binding and skinning. The bone binding determines the position of each bone in the model, and the skinning will calculate the bone weight for each vertex in the model. The purpose of this step is to determine the position of each bone used in the character animation in the cartoon model, so that the vertex weights are subsequently

calculated. The skeleton (Skeleton) is composed of a series of bones. The bone structure used in character animation has a hierarchical structure, that is, a bone will contain a child node and a parent node.

## III. EXPERIMENT

Augmented reality technology is shown in the figure.



smooth and accurate behavior control, and it can be used in visual modeling simulation teaching to improve the perception and teaching quality. This article only conducts research on character modeling and behavior control in 3D virtual animation design. In the future, we should continue to study scene construction in 3D virtual animation design to further enhance the lifelike experience of the overall animation scene.

#### V. ACKNOWLEDGEMENT

This research has been financed by Wuhan Vocational College of Software and Engineering, in 2020 "Research on Digital Curriculum from the Perspective of "Artificial Intelligence + Education"" (2020X022 )

#### REFERENCES

- [1] Zhang Fan, Li Shunman, Wang Ziwen. Development and Application of Augmented Reality Technology in Educational Software for Children's Behavior and Habit Formation——Taking "Pea Planet AR Magic Sticker" as an example [J]. New Curriculum Research: Late, 2019(8): 3.
- [2] Flavia Sparacino, Christopher Wren, Glorianna Davenport, etc. Application of Augmented Reality Technology in Dance and Drama [J]. Performing Arts Technology, 2018, 000(003): 40-43.
- [3] Jin Wenyue. Research on character modeling and behavior control based on virtual animation design[J]. Modern Electronic Technology, 2020, v.43; No.568(17):118-122.
- [4] Sun Bing, Li Shenghui. Application of Augmented Reality Technology in Packaging Customized Products[J]. Printing Today, 2018, 000(002):45-46.
- [5] Tai Xinran, Zheng Yan. 3D animation character modeling analysis and technical application based on 3dsMax[J]. Chinese Cifu, 2018(10): 2.
- [6] Tang Zhi. Research on mobile terminal 3D modeling technology based on visual SLAM[D]. Huazhong University of Science and Technology, 2018.
- [7] Lin Yongjian. On the application of cartoon images in the visual design of theme park brands[J]. Science and Technology Vision, 2019, 000(019):158-159.
- [8] Zhou Rongting, Gu Fei. Research on the Personification Innovation Path of Augmented Reality Children's Books[J]. 2021(2017-24):6-9.
- [9] Tian Liang. Research on key technologies of augmented reality based on deep learning [D]. Hebei Normal University, 2019.
- [10] Sun Youquan. Research on the Application of Cartoon Images in the Design of Children's Food Packaging[J]. Artist, 2019.
- [11] Chi Qiancheng, Li Xin. Cartoon character movement technology based on deep learning, CN110232729A[P]. 2019.
- [12] Wei Jun. The application of cartoon elements in color teaching [J]. Art Education Research, 2020, 000(003):158-159.
- [13] Wu Fei. Design and implementation of face cartoon animation system combining facial expression and deformation technology[J]. Modern Electronic Technology, 2018, 041(012):56-58,62.
- [14] Shi Tingchun, Shao Yinqiu. A mathematical modeling method based on visual intelligence analysis, CN111524182A[P]. 2020.
- [15] Zhou Kai Kai Zhou, Wang Xiangjun Xiangjun Wang, Wang Zhong Zhong Wang, et al. Design and modeling of large visual range visual pose measurement system[J]. Laser & Optoelectronics Progress, 2019, 56(11):111504.
- [16] Dai Minhong, Zhao Baochun, Ma Ruizhi. The importance of artistic human body proportions in MAYA 3D animation modeling[J]. Electronic Technology and Software Engineering, 2018, No.131(09):66-66.
- [17] Sun Youquan. Analysis of the application of cartoon images in brand visual image[J]. Tomorrow's Fashion, 2019(12).
- [18] Guo Renchun, Qian Ziyang, Yu Jinhong, et al. Application of Augmented Reality Technology in the Construction of School History Museum[J]. Journal of Shenyang University of Chemical Technology, 2019, 033(001):93-96.
- [19] Zhang Zhuoqun, Cao Zhongmiao, Wang Hui. Application research of computer vision and machine learning technology in 3D human animation[J]. Network Security Technology and Application, 2019, 000(008):109-110.
- [20] Kong Manlu, Zhou Qian, Wang Dongmei. Application of 3D animation modeling technology in the composition design of tea packaging[J]. Fujian Tea, 2018, 40(012):144.
- [21] Zhao Zhiyu. Applied research on the design and storytelling of cartoon brand image spokesperson in the era of new media[J]. Fine Arts Research, 2019, No.185(05):90+99-101.
- [22] Chen Youlian, Zhong Shanglian, Peng Wenli. The application of cartoon images in the design of children's products[J]. 2021(2015-1):155-155.
- [23] Chen Gong, Sun Haibo, Zhao Lala, etc. Application analysis of information technology in practical teaching of engineering graphics[J]. Science and Information Technology, 2019, 000(001): 121-123.
- [24] Cao Huai, Dong Sijie, Feng Chong. Discussion on the production methods and prospects of simulation 3D animation in the field of high-tech product design[J]. Mechanical and Electrical Engineering Technology, 2019, 48(01):75-80.