Exploration of Animation Design Collaboration Mechanism Combining Mixed Reality and Intelligent CAD System

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Abstract. The collaborative mechanism of mixed reality (MR) in human-computer interaction in animation design today cannot be separated from intelligent CAD systems. In order to explore the collaborative mechanism of animation design in intelligent systems, this paper integrates and constructs an advanced virtual reality interactive environment model. Real-time interaction under an intelligent algorithm mechanism was constructed by capturing and simulating animation elements. This article adopts a different testing and analysis mode from traditional animation and verifies the changes in quality indicators of design efficiency by comparing the mixed simulation process of traditional animation. In the experimental verification stage, advanced indicators were used for extensive testing analysis and efficiency comparison in this article. The research results demonstrate that the transmission efficiency and human-machine animation collaboration mechanism in this article are more efficient. More intuitive analysis of efficiency and quality indicators in animation design. This combination not only breaks through the limitations of traditional animation design but also greatly improves design efficiency and creative quality, providing animation designers with a broader creative space.

Keywords: Mixed Reality; Intelligent CAD Systems; Animation Design; Collaborative Mechanisms
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1 INTRODUCTION

The innovation of hybrid animation technology provides a clear graphic reality interaction for the current intelligent analysis of animation. The current intelligent CAD has brought relatively direct applications to the field of animation design. Collusion detection is often required to enhance the realism of automatically generated animations. The most primitive collision detection method is very cumbersome, requiring pairwise intersection testing of all geometric elements in the detection model. Although accurate results can be obtained, as the complexity of the model increases, the computational load also increases exponentially, making the speed of intersection testing very slow and unable to meet the requirements of the system. It should be noted that collision detection is performed between dynamic characters. Other types of collisions, such as self-collision detection of characters and collision detection between characters and static objects, are carried out during the separate processing of each action. Bao [1] discussed that dynamic characters (hereinafter referred to as characters) refer to character roles. Although different characters have different body types, the structure of each part of the body is the same. From the perspective of 3D animation production, character actions are driven by the character's skeleton. In its project, all character skeletons adopt a hierarchical structure of 72 joint points. When constructing the OBB hierarchical structure of characters, skeleton data and character model data will be used as the basis. Due to the unity of skeleton structure, automatic character hierarchical structure division is possible. 3DS MAX is a powerful application software that integrates 3D modelling and animation production. With its affordable price and excellent performance, it has won the favour of a large number of microcomputer users. AutoCAD is the most popular graphics software package in the world today, which not only has a complete set of 2D CAD functions but also has true 3D production capabilities. In the CAD industry, 3D animation technology has caused significant changes in product design, production, and other aspects. Bora and Jain [2] used animation technology to simulate the trajectory of mechanism motion and can dynamically verify it. It has made real-time modifications to the new product design scheme and rotated the display, simulating the machine's assembly process. Perform strong stiffness analysis and calculation on the main components using finite element software. It can also display advertisements and simulate on-site for the final product. These are all based on 3D solid modelling, which is the core technology of CAD/CAM integrated systems. Mechanical designers and engineering technicians need to understand and master the basic methods of 3D modelling and animation production techniques.

In the 1990s, computer graphics technology began to be widely applied in the field of animation production. On the one hand, digital technology has revolutionized the traditional concept and methods of animation production, breaking the traditional frame-by-frame shooting method. Chen et al. [3] used digital image data to create animations, transforming traditional brushes into digital brushes, and making the animation more realistic. On the other hand, CG technology subverts and reinterprets the original definition of animation ontology, blurring the boundary between animation art itself and the generalization of CG technology. Currently, digital animation technology has become the mainstream of the animation industry worldwide. Compared to handmade animation, its production cost is lower, but it also suppresses the market space and aesthetic exploration space of handmade animation. By examining the development history of animated films, it was found that digital animation technology has had a profound impact on the animation industry. By examining the media, aesthetic, and ontological characteristics of handmade animated films, we aim to explore their unique value in the current global animated film industry. And combined with the script "The Kingdom of Divine Painting", explore the cultural connotations and aesthetic values of handmade animated films. Chen et al. [4] explored the animation style fusion work creation model based on the Recurrent Consistency Network (CycleGAN). It analyzes how artificial intelligence empowers art education and promotes the inheritance and innovation of animation art. The discriminator network attempts to distinguish between the data generated by the generator and the actual training data. These two networks confront each other during the training process, ultimately enabling the generator to generate new data similar to real data. Which trains two sets of mirror symmetric GAN networks to achieve the conversion between images of different styles. In the creation of animation style fusion works, we can use CycleGAN to integrate modern painting style with animation style, creating artworks that combine traditional charm and modern atmosphere. Mixed Reality technology combines the latest achievements of Virtual Reality (VR) and Augmented Reality (AR) to integrate digital information with the real environment, creating a new interactive experience for users. Virtual Reality is a digital technology that enables users to immerse themselves in the real world or completely fictional scenarios through computer-generated virtual environments that simulate the real world. This technology places the user in a simulated three-dimensional environment through devices such as head-mounted displays, grips, or gloves, and realizes visual, auditory, tactile, and other multi-sensory interactions. The core idea of this method is to extract features from source images and animation art-style images through deep learning techniques. Han et al. [5] used generative adversarial networks to fuse these features and generate images with specific animation art styles. This method not only preserves the basic structure and content of the source image but also successfully integrates animation art style into it. Make the generated image both aesthetically pleasing and maintain the authenticity of the original image. The depth feature extractor is used to extract the key features from the source image and animation art style image, and the generation of an antagonistic network generates the image with the target style according to these features.

In the context of the digital media era, facing the constantly improving technological level of society, the traditional manual drawing mode often faces problems such as long production cycles and large investments of human and financial resources in producing two-dimensional animations. At present, a computer two-dimensional animation production technology, keyframe technology, has emerged in the market. The emergence and application of this technology have provided important technical support for the production of two-dimensional animated films. The introduction and application of computer technology not only effectively shortens the production cycle of 2D animation, but also improves the quality of 2D animation production. Hattler and Cheung [6] discussed the drawing of various images and stored them in a designated computer using digital information. This provides great convenience for the production of digital animation in the later stage, fully meeting the needs of animation production. During the production of digital animation, the application of motion captors can make the animation effects of character movements smoother and more natural. At present, with the continuous improvement of technology, motion capture devices are widely used in animation film production and have achieved good application effects. The design team adopted a combination of mixed reality and intelligent CAD systems to achieve high efficiency, accuracy, and innovation in the design. The combination of mixed reality and intelligent CAD systems has achieved significant results in the design of the three-dimensional abstract animation device in its case. The design team successfully constructed a device model with a unique form and dynamic effect. Virtual reality technology has been widely used in entertainment, education, medical treatment, military and other fields, providing users with a new way of experience, and is constantly developing and improving, bringing infinite possibilities for future technology and life. Ho et al. [7] explored the role of 3D painting in improving students' learning level of 3D animation in virtual reality from a sustainability perspective. VR technology allows students to immerse themselves in painting creation by simulating a real three-dimensional environment. This immersive experience 3D spatial structures, master 3D painting techniques, and lay a solid foundation for their subsequent 3D animation learning. From a sustainability perspective, 3D painting in VR technology helps improve students' self-directed learning abilities. Students can gradually master 3D drawing skills and improve their level of 3D animation creation through repeated practice. This process of self-improvement not only enhances students' learning confidence but also helps to cultivate their innovative spirit and practical ability.

Augmented reality technology is also a digital technology that superimposes computer-generated virtual information with the real world, fusing virtual elements into real scenes to enhance the user's perceptual experience. Through the screen of a smartphone or the window of a head-mounted display, users can see the real world that integrates virtual elements. By utilizing artificial intelligence CAD technology, production technicians can obtain the best computer graphic performance works. Secondly, apply a 3D dynamic capture system to capture and transmit on-site actions. When making virtual movies, a 3D dynamic capture system is used to transmit and store captured live actions to the computer. Connect the camera directly to the computer, and during shooting, the scene in the computer will change with the movement of the camera's shooting position. Use these devices and software to capture body posture movements and facial expressions of characters. Effectively combining computer-generated characters with real-world performances. The actors in this film can effectively communicate and interact with the characters created on the computer. Although the virtual characters in computer graphics are already very realistic, their ability to capture expressions is somewhat unsatisfactory.

Overall, the introduction of mixed reality technology has provided designers with more intuitive and immersive design environments, while the continuous development of intelligent CAD systems has provided more possibilities and convenience for the design process. However, despite the significant progress made by these two technologies in their respective fields, their integrated applications in the field of animation design are still relatively few. Therefore, this paper aims to bring more innovations and breakthroughs in the field of animation design by exploring the animation design collaboration mechanism that combines mixed reality and intelligent CAD systems. Through this research, we expect to provide designers with more powerful and efficient tools and methods and to promote the animation design field in a more diversified and innovative direction. Such an exploration is expected to further enrich the expression of animation production, improve the quality of animation works, and provide creators with a more colourful creative experience.

2 RELATED WORK

The pencil drawing style is a popular art form, and its unique visual effects and expressiveness bring infinite possibilities to animation design. Jin et al. [8] proposed a space rendering network for pencil drawing-style animation design, aiming to achieve efficient and realistic pencil drawing-style animation design. This module uses deep learning technology to learn its unique line and colour features from a large number of pencil drawings. Through the style conversion of the input animation frame, it presents the visual effect of the pencil drawing style. The module is responsible for simulating the light and shadow effect and sense of space in pencil drawings. By adjusting the brightness, contrast, shadow, and other parameters of the picture, the animation frame can maintain the pencil drawing style and present a more realistic and three-dimensional spatial effect. By utilizing techniques such as 3D scanning, modelling, and rendering, Jing and Song [9] accurately restored objects and scenes in the real world, making animated characters and scenes more realistic and vivid. This highly realistic visual effect not only enhances the audience's immersion but also makes animated works more attractive and competitive. The traditional animation design method often depends on the designer's hand-painted skills and imagination. However, with the increasing expectation of the audience for the visual effect of animation works, the traditional design method has been difficult to meet the market demand. Therefore, the introduction of 3D reality technology combined with CAD systems has brought revolutionary changes to animation modelling design.

By utilizing techniques such as 3D scanning, modelling, and rendering in virtual reality, Li et al. [10] accurately captured and restored objects and scenes in the real world. Then, the highly realistic 3D models in the virtual environment will be created. Digital technology has revolutionized the traditional concept and methods of animation production, breaking the traditional frame-by-frame shooting method. It uses digital image data to create animations, transforming traditional animation brushes into digital brushes. This makes the animation more realistic. On the other hand, CG technology has overturned the material foundation of active images and blurred the boundary between photographic films and animated films. Compared to manual animation, digital animation has lower production costs and higher efficiency. Looking at the current global animation market, it is found that digital animated films occupy a large market share, and digital animation technology has become the mainstream of the animation industry worldwide. Under the mainstream of this market, the intrinsic value of animated films is gradually disappearing, handmade animation is gradually being marginalized, and its market space and aesthetic exploration space are repeatedly suppressed. Mueller et al. [11] analyzed individual data and pixels in digital 3D animation. It replaces the lines and colour blocks manually drawn by animators. And 3D animation is different from the grid-by-grid drawing of hand-drawn animation. It uses the Cartesian coordinate system for modelling and sets corresponding parameters at the starting and ending points of keyframes. The computer will automatically generate the intermediate animation process, and then complete the animation through rendering, resulting in a realistic visual effect.

Wang [12] explored the characteristics of digital animation interactive applications and their profound impact on the art field. Digital animated films were originally born as an invention, embodying the wisdom and efforts of numerous scientists. This period fully embodies the technological ontology of animated films; With the continuous maturity of technology, and aesthetic participation in animation creation, digital animation has gradually become a beautiful art form, reflecting the artistic essence of animated films. The development of digital animation technology has gradually led animated films to a "hyper-realistic" level. The Hollywood animation production company led by Disney has turned this digital animated movie into a model. Gradually neglecting the artistic essence of animation. The boundary between animated films and live-action films is constantly blurred. At the same time, it also brings about an aesthetic dilemma of "hyperrealism". On the other hand, handmade animation is completed step by step through hand drawing, sculpture, and other methods, which gives it an aesthetic sense of artistic ontology - that is, based on the artistic characteristics of art. Handmade animation artists create their works with different materials, resulting in various technical differences. Ultimately, this leads to different animated works being created. Therefore, various forms of animated works can reflect the comprehensive characteristics and aesthetic diversity of handmade animated films. 3D animation and virtual reality technology are currently representative technologies in 3D graphics and image representation. The advantages of 3D animation technology and foot simulation in terms of six aspects are incomparable to other similar technologies. Among them, 3D animation technology has become an indispensable means for high-quality film and game production. New 3D animation technologies such as 3D animation capture systems pose powerful challenges to traditional 3D animation technology research in terms of technical theory. Virtual reality technology is mainly applied in simulation and is an interactive technology, such as scene reproduction, urban planning, scheme simulation and demonstration, entertainment, flight training, etc. Wang et al. [13] focused on exploring the key technologies of these two technologies in their respective development and application processes, starting from their principles and characteristics. And through case studies on the application of two technologies in 3D animation scene modelling and virtual studio technology. Further demonstrated the advantages of 3D animation and virtual reality technology in their respective fields from both theoretical and technical perspectives.

Xu and Xu [14] analyzed the combination of digital animation and human-computer interaction in traditional culture. The vast number of traditional paintings provides endless reference resources for contemporary digital media art creation, including shapes, colours, stories, and more. The reason why Chinese art can endure for a long time is mainly because it insists on inheriting and developing traditional Chinese culture. The development of animation art has evolved from frame-by-frame drawing to the integration of digital technology, from two-dimensional planes to three-dimensional solids. Every breakthrough and innovation in animation art is closely related to the development of technology. Especially with the emergence of digital technology, traditional animation art has rapidly developed, bringing infinite imagination and room for progress to animation art. Three-dimensional animation technology is closely related to current social life. In terms of modelling, the degree of realism it creates is often better than two-dimensional depiction, which is a new direction worth exploring. The combination of traditional painting and animation technology undoubtedly expands another way and possibility of inheriting and promoting traditional Chinese art by combining traditional forms with new technologies. Zhang and Rui [15] showcased traditional painting in the virtual world through digital technology. This exploration will be a beneficial combination of excellent traditional culture and modern virtual technology. Its main purpose is to achieve the intersection and integration of traditional art and technology, truly allowing the public to showcase the true emotional essence of static images through lively and emotionally rich dynamic images through media. Its research has achieved the role of inheriting and promoting traditional Chinese culture, enabling the effective development of traditional Chinese painting art under the promotion of digital technology. It fully demonstrates the innovative value of the combination of traditional Chinese art and modern technology, awakening cultural works that have weathered wind and rain, and promoting the continuation of Chinese cultural spirit.

Zhao et al. [16] explored the comprehensive analysis of the three-dimensional sense of characters in images using CAD digital technology. Among various animation software currently popular in the market, 3D animation creation software accounts for a very large proportion. People who have watched 3D animation will be attracted by the fascinating world of animation. With the rapid development of science and technology, as well as the continuous improvement of computer software and hardware functions. With the continuous decline in computer prices, various software companies are constantly launching new versions of software. The creation of animated short films in this project will be carried out using three-dimensional animation technology, skillfully integrating traditional Chinese painting elements with popular culture through painting and digital technology. Computer-intelligent CAD image processing technology can achieve precise pixel-level processing of images, making painting and animation works more delicate and realistic. Through automated and intelligent processing algorithms, the cycle of painting and animation creation has been greatly shortened, and the efficiency of creation has been improved.

3 SELECTION OF MIXED REALITY HARDWARE AND SOFTWARE

3.1 Microsoft HoloLens 2 Industrial Edition

In a mixed reality environment, the entities of the physical world and the virtual content of the digital world can be integrated in real time, creating an interactive space that is both real and illusory. It blends virtual digital elements with the real environment, enabling a high degree of interaction and integration between the human user, the computer system and the surrounding environment. This form of interaction not only provides a more intuitive and immersive experience but also provides users with a new space for exploration and creation. The development of mixed reality technology allows people to interact with digital information and virtual scenarios in unprecedented ways, thus advancing human-computer interaction technology and expanding the boundaries between humans and technology. Figure 1 below presents two examples of mixed reality applications, the hardware device worn by the character in the figure is Microsoft HoloLens 2, which was selected as the hardware tool for this study.

Figure 1: Examples of mixed reality applications.

The HoloLens 2 Industrial Edition demonstrates significant benefits in several ways, not only in terms of increased computing performance compared to its regular version but also in terms of a significantly improved display. This enhancement means that the Industrial Edition can handle a large number of computing tasks more quickly and accurately and present clearer and more realistic visual effects. At the same time, the Industrial Edition has been designed with more comprehensive considerations, enabling it to operate stably in a variety of complex environments without being affected by external factors. This feature is particularly important for the field of animation design, because animation design often needs to be carried out in different scenes, and the multi-environment adaptability of HoloLens 2 Industrial Edition can effectively meet this demand, providing designers with a more flexible and convenient working environment. Therefore, it can be said that the performance and characteristics of HoloLens 2 Industrial Edition are more in line with the requirements of this study for animation design tools, providing more ideal hardware support for the study. Figure 2 shows the structure and wearing style of the HoloLens 2 industrial version.

Figure 2: HoloLens 2 industrial edition structure and wearing style.

The Microsoft HoloLens 2 Industrial is a mixed reality head-mounted display device that utilizes optically projected Waveguide display technology with a 2K 3:2 imager that provides a field of view (FOV) of approximately 52 degrees. Motion trajectory refers to a standardized description of the properties of an object (including position, size, shape, colour, etc.) that change over time. In computer 3D animation, motion trajectories can be set for objective objects themselves, light sources, and virtual cameras. In certain frames (called keyframes), the position and attributes of the object are pre-set, and then spline or linear interpolation is performed between these keyframes to complete the setting of the motion trajectory. Control the motion of objects through the mutual influence between these joints. This type of method is particularly suitable for the motion design of objects with joints, such as humans, animals, machines, etc. Utilize the relationship between objects, perform spline or linear interpolation, and incorporate time factors to achieve the deformation and motion process of objects.

3.2 WebXR Development with JavaScript

JavaScript is an object-oriented client-side scripting language developed from LiveScript in Netscape. The main purpose is to solve the problem of slow speed in server-side languages such as Perl and improve browser response speed. After introducing JavaScript into web pages, they become more vivid and flexible. JavaScript adopts an object event-triggering mechanism. When a webpage listens to an event triggered by a certain element, it will call the corresponding event processing function, and finally return the function processing result to the page element being called.

1) It is an interpretive scripting language that makes it easy to write functional code snippets. These JavaScript programs do not need to be compiled in advance. They are executed line by line during browser loading and running.

2) It is object-oriented. Developers can use it to create their own desired objects or use its built-in objects such as dates, regular expressions, etc.

3) Has event-driven characteristics. Because JavaScript is event-driven, it perfectly meets the needs of front-end development for interactive pages. After binding a page object to a corresponding event listener, when the corresponding operation (such as a click operation) on the page element is heard, the bound event handler will be called to complete specific functions.

4) Has security. The code can only run in the user's client browser to ensure security.

5) Has platform independence. Because it is interpreted and executed by the browser, it can run on different operating platforms, only related to the browser that runs it.

The main purpose of website front-end development is to improve the user experience as much as possible. At present, browser users are increasingly demanding, and users are also important participants in the Internet, requiring participation and creation in the Internet. Therefore, interaction will be one of the important themes of the Internet. JavaScript has become the most popular design language for web front-end development due to its unique features.

$$z_i = W_0^i \times x[start_i : end_i] = (w_i, v_i^1, v_i^2, \ldots, v_i^K) \tag{1}$$

Initialization of the vector FM for the first layer can be obtained:

$$y_{FM} = sigmoid(w_0 + \sum_{i=1}^{N} w_i x_i + \sum_{i=1}^{N} \sum_{j=i+1}^{N} x_i x_j) \tag{2}$$

When it comes to improving performance, JavaScript can be implemented through various strategies, such as using request animation frames to synchronize animation rendering with browser refresh rates, avoiding unnecessary redraws and rearrangements, and optimizing data structures and algorithms. Adding implicit layer weights to the algorithm model and calculating them to predict FM weights may involve the training and inference process of deep learning models. This process can be performed using JavaScript, especially in the Node.js environment, where many libraries for machine learning, such as TensorFlow. js can support this type of computation.

$$L(y, \hat{y}) = -y \log \hat{y} - (1-y) \log(1-\hat{y}) \tag{3}$$

$$L(\theta) = L + \lambda \left\| \theta_i \right\|_1 \tag{4}$$

Similar to the L1 regularity, the L2 regularity adds a parameter to the loss function but switches the Eulerian paradigm, which is expressed as:

$$L(\theta) = L + \lambda \left\| \theta_j \right\|_2 \tag{5}$$

A comparison of the two reveals that L1 regularity favours smaller JavaScript software models because the solutions it computes are more sparse. Therefore, for outlier features, L1 regularity will not give too much weight, and the results obtained will lose some accuracy. Also, in order not to overfit, this study uses L2 regularization, which is regularized as follows:

$$\Omega(w) = 2\left\| W_0 \right\| + \sum l = 3\left(\left\| W_l \right\|^2 + \left\| b_l \right\|^2 \right) \tag{6}$$

Calculate the error generated by the software for each iteration as:

$$\delta_j = \frac{\partial L}{\partial z_j} = \frac{\partial L}{\partial a_j} \times \frac{\partial a_j}{\partial z_j} = \nabla a_j \times \sigma(z_j) \tag{7}$$

Vectorization is then performed to obtain:

$$\delta^L = \nabla a^L \odot \sigma(z^L) \tag{8}$$

$$\delta_j = \frac{\partial C}{\partial z_j} = \sum_k \frac{\partial C}{\partial z_k} \times \frac{\partial z_k}{\partial a_j} \tag{9}$$

$$\sum_k \delta_k w_{kj} \sigma(z_j) = \sum_k \delta_k \times \frac{\partial(w_{ki} a_i + b_i)}{\partial a_j} \tag{10}$$

The gradient of the HoloLens software model weights is:

$$\nabla w_{jk} = \frac{\partial C}{\partial w_{jk}} = \delta_j \frac{\partial(w_{ki} a_i + b_i)}{\partial w_{jk}} \tag{11}$$

The bias gradient for each layer in the model structure is:

$$\nabla b_j = \frac{\partial C}{\partial b_j} = \delta_j \frac{\partial (w_{ji} a_i + b_i)}{\partial w_{ji}} \tag{12}$$

Within this gradient range, the final HoloLens software model for WebXR development using JavaScript is obtained by taking into account the derived error.

4 EXPLORATION OF ANIMATION DESIGN USING MODEL COLLABORATION MECHANISMS

This study explores the possibility of integrating HoloLens software models with intelligent CAD systems. By integrating the HoloLens software model with an intelligent CAD system, we can achieve a more intelligent and intuitive animation design experience. This integration means that during the animation design process, designers can interact directly with the CAD system through the HoloLens head-mounted display device to create and edit animation elements more efficiently. The network contains 34 nodes connected by 154 undirected and unweighted edges. Each node is classified into one of four categories which are obtained by a modularity-based clustering method. The relevant details are shown in Figure 3 below.

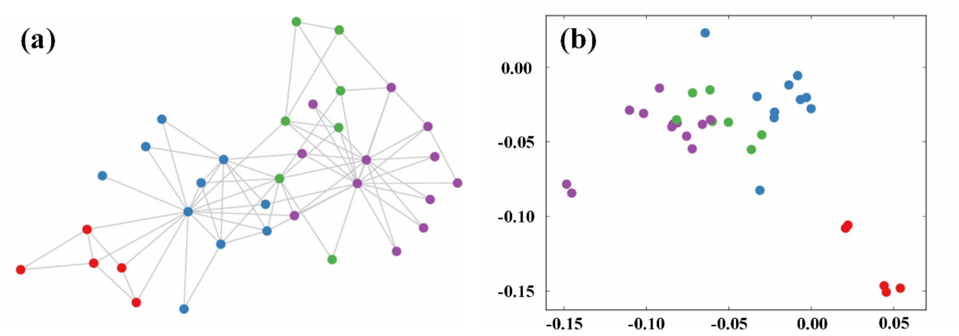

Figure 3: Collaborative network structure of intelligent CAD system.

The figure on the left in the above figure shows (a) the intelligent CAD system network, with the colours indicating animated pixels obtained through modularity-based clustering. The (b) figure on the right is an embedding obtained from an untrained HoloLens software model that applies the weights of animated random pixels to the smart network, which can be viewed on the screen of the HoloLens2 Industrial Edition.

At each co-painting, this experiment uses the hardware built-in optimizer to train 400 loop processes without early stops with a learning rate of 0.01, a learning rate of 0.5 for the first and last stops, and several 16 units per binding layer. The results of training using the selected hardware and software are shown in Figure 4 below.

The markers in Figure 4 above indicate the average classification accuracy for 10-fold co-validation. The shaded area indicates the standard error. The dashed line in this study shows the standard model, and the solid line shows the training and testing results of the HoloLens software model. Facing the two models named Citeseer and Cora respectively, it can be seen that the latter has a higher upper limit of synergy performance, reaching 0.95, and both the solid and dashed lines are smoother and causing a smaller shaded area than the former, indicating that this model has a better synergy performance and a smaller error. In animation, yellow, green, and blue and the transition colors between them have always been quite tricky. The results are shown in Figure 5 below.

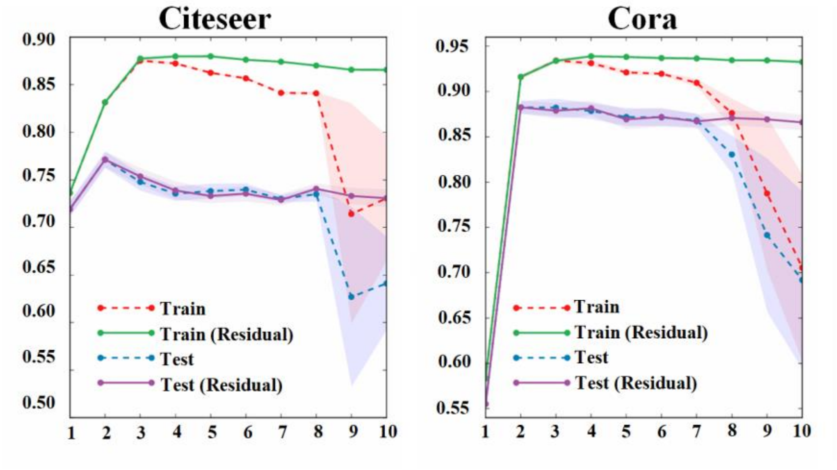

Figure 4: Effect of HoloLens software model depth on synergy performance.

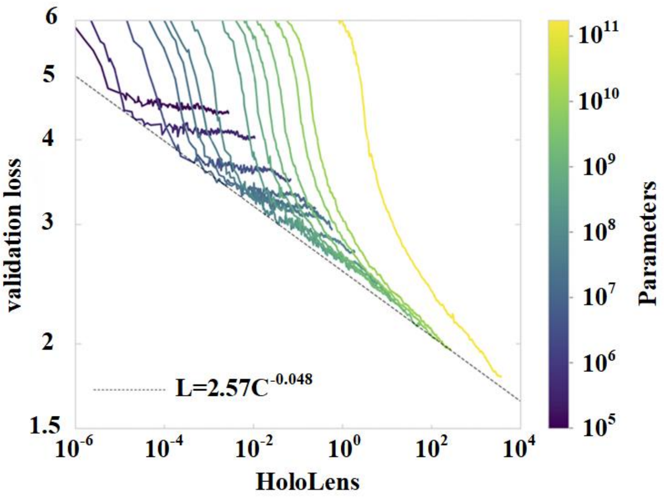

Figure 5: Co-model smoothness test results.

The dotted line in Fig. 5 indicates the processing performance of the colour, and above the dotted line is excellent performance. From the above figure, it is obvious that in the processing of this colour scale, the model established in this experiment is in the excellent part. It has quite good recognition and the coloring ability for yellow, green, and blue, as well as transition colors, which indicates that the model established in this study is very useful for animation design.

The cost consumed for processing each frame in animation design is huge in the traditional mode. Whereas, the combination of Mixed Reality and intelligent CAD systems allows the cost of animation production to be decreased. Therefore this experiment, using the established model, tested the distribution of animation frames with different byte lengths as well as the cost.

Figure 6 shows the results obtained from the experiment; the left figure shows that most of the byte lengths of each frame in the sample animation are in the range of 0 to 500, so handling this part of the frame is the focus direction of the model. In the right figure, it is seen that in the range of 0 to

500 bytes, the model built in this experiment keeps the cost per frame within 20 cents, which shows that this experiment has the effect of saving money.

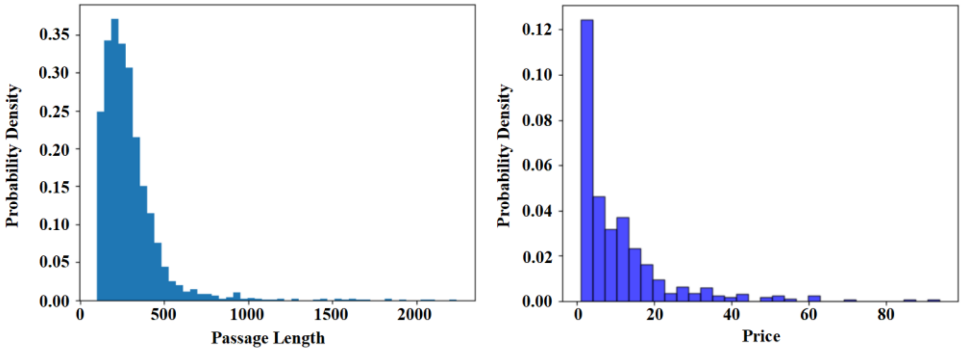

Figure 6: Animation frame byte length distribution and cost.

On the basis of the above performance tests, the process animations of the two games were processed in this experiment, and the results obtained are shown in Figure 7 below.

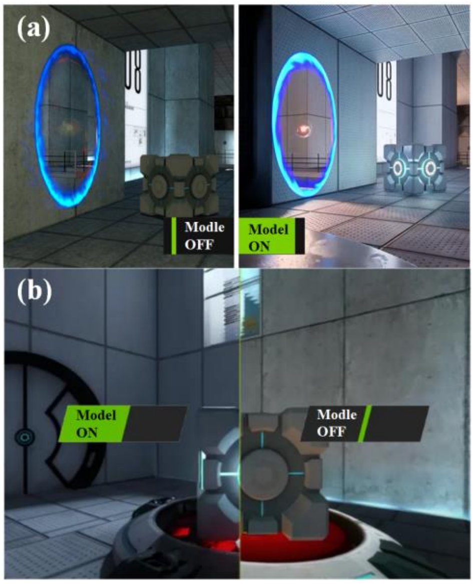

Figure 7: Comparison of model effect on animation processing.

As can be seen from the comparison of Fig. (a) of Fig. 7 for the same frame of animation, the material of the scene has been greatly improved after using the model of this experiment of the synergistic cooperation between the mixed reality and the intelligent CAD system, both the panels of the floor and the wall, and the cement feeling of the cube have been improved very much, and the effect of the simulation has been greatly improved. In Figure (b), the left and right sides of the same frame of animation were processed, and it can be seen that on the left side of the model that has been used, the light and shadow effect is more real, especially the red light at the base of the cube, which is not an irrational piece, but with the shape of the cube to emphasize the shadow. It can be seen that the use of mixed reality and intelligent CAD systems for animation design can greatly improve the quality and performance of animation.

5 SUMMARY

This paper first introduces the classification and application of Mixed Reality technology, followed by an introduction to Intelligent CAD systems, and both are viewed and analyzed. After that, detailed research is done on the development and latest progress both at home and abroad, pointing out the journey as well as the shortcomings. After that, this study selected Microsoft HoloLens 2 Industrial Edition as the hardware for the experiment and designed the experimental software using JavaScript programming language. Finally, the large model required for the experiment was created by integrating it with an intelligent CAD system. The aim of this study is to deeply explore the animation design collaboration mechanism that combines mixed reality technology and intelligent computer-aided design systems. This article proposes a major solution to the problem of modelling virtual scenes worldwide. The feasibility and basic method of constructing virtual 3D scenes by combining 3DS MAX technology in 3D animation. Further clarification has been made that flexibly selecting modelling techniques based on the complexity and realism of virtual scenes will be the main research focus of 3D modelling in future virtual scenes. In the process of providing evidence for key technical examples of 3D animation and in-depth exploration of virtual animation character performance technology, the complexity and diversity of research on 3D animation technology have been clarified. And how to fully apply the built-in modelling and deformation plugins in 3DS MAX in capturing the facial movements of virtual animated characters. In the exploration of Morpher technology and the analysis and introduction of joint animation principles and motion capture systems. It points out the significant driving force of computer software and hardware technology in the development of 3D animation technology that cannot be ignored. The stability of the model performance and the scope of the application still need to be further verified. In addition, the experimental sample size may not be large enough, resulting in the reliability of the experimental results to be confirmed. Finally, although the experimental results in cost control are mentioned, a comprehensive analysis of cost-effectiveness is lacking, and more in-depth research is needed. In order to further improve the study, future research directions include expanding the application scenarios, optimizing the synergistic mechanism model, analyzing the cost-effectiveness in-depth, and enhancing the user experience design. These efforts will help to improve the universality and practicality of the technology, meet the design requirements under different demand scenarios, provide more comprehensive data support for decision-makers, and improve the user experience.

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