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Research on the Application of AIGC Technology in Three-Dimensional Animation Creation

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Abstract

In recent years, AIGC technology has seen widespread application within the field of animated content production. This paper focuses on exploring the application of AIGC technology in three-dimensional animation creation. It first elucidates the concept and core characteristics of AIGC technology, subsequently introduces the traditional workflow of three-dimensional animation creation and the challenges it faces, and then examines the specific pathways through which AIGC technology empowers three-dimensional animation creation.While demonstrating how AIGC technology has permeated and empowered every stage of 3D animation production, ushering in unprecedented transformation, this paper also addresses existing limitations of AIGC technology.

Keywords

AIGC technology, 3D animation production, production workflow, automatic generation

1. Introduction

In recent years, Artificial Intelligence Generated Content (AIGC) technology, centred on deep learning and generative models, has advanced remarkably. It has demonstrated exceptional content creation capabilities across domains such as article writing, image generation, and video editing.As the underlying technologies mature, AIGC has gradually entered the realm of three-dimensional content production, introducing novel possibilities to animation workflows. Applying AIGC to 3D animation enables varying degrees of intelligence and automation in character design, scene construction, and animation sequence production. This not only enhances efficiency but also significantly transforms creative methodologies.

2. The Concept and Core Characteristics of AIGC Technology

AIGC technology, as the name suggests, refers to the automated generation of diverse content through artificial intelligence. Leveraging deep learning, natural language processing, and computer vision, it can autonomously produce articles, images, audio, video, and other content types. The advent of AIGC has revolutionised content creation by moving beyond traditional manual-dependent methods, ushering in a new era.

The most fundamental characteristic of AIGC technology is its exceptional production efficiency. Previously, whether composing an article, creating a painting, or filming a video, creators had to invest substantial time and effort. AIGC technology, however, possesses formidable computational power and sophisticated algorithms, enabling the generation of vast quantities of content within remarkably short timeframes.Furthermore, multimodal fusion represents another significant aspect of AIGC technology. It supports cross-media content generation, comprehending and processing diverse data types such as images, text, and audio, whilst enabling seamless conversion and integration between different modalities.

3. The Process and Challenges of 3D Animation Creation

3.1 Traditional Workflow of 3D Animation Production

The 3D animation creation process is systematic and complex, broadly divided into three stages: pre-production planning, mid-production, and post-production.

The pre-production phase serves as the foundational groundwork for animation creation, directly determining the work's stylistic direction, narrative logic, and production feasibility. It also constitutes the initial conceptualisation and planning of the story, characters, and settings, encompassing the following key stages: creative ideation and thematic positioning, scriptwriting and world-building, concept design, character/scene/prop design, and storyboard development.During pre-production, the first step involves defining the animation's core theme and target audience in the creative conception and thematic positioning phase, establishing the overall tone—whether comedic, poignant, or science fiction. Subsequently, in the scriptwriting and world-building phase, the script is drafted while constructing the entire narrative's world-building framework, including the story's era, location, and any unique rules or conventions.The concept design phase involves creating core visual references, such as overall style guides, atmospheric setting sketches, and preliminary character designs. Building upon these concepts, the designs for characters, settings, props, and storyboards are then refined. Storyboard design specifically entails translating the script into visual storyboard sketches, enabling a clear visualisation of each shot's content.

The mid-production phase of 3D animation creation is the pivotal stage where all conceptual ideas from the pre-production planning phase are brought to fruition. This involves transforming design drafts into tangible 3D models and animated sequences, encompassing the following key processes: 3D modelling, material and texture creation, lighting and camera setup, and animation production. First,

creators must build three-dimensional models of characters, environments, and props within 3D software based on the design drafts. Subsequently, these models are 'dressed and skinned' – that is, materials and textures are applied to impart tactile qualities such as metallic sheen or the drape of fabric. Realistic lighting effects are then simulated, and camera angles and trajectories are replicated from the storyboard to establish the desired visual atmosphere.Finally, animators must rig the characters with skeletal structures and employ keyframe animation techniques to execute movements, facial expressions, and environmental dynamics as specified by the storyboard and script. This encompasses actions like walking, running, or camera movements such as pans, tilts, and dolly shots.

The post-production phase of 3D animation creation is pivotal in determining the final visual outcome, comprising the following key stages: rendering output, sound effects and soundtrack production, and final compositing. Creators employ specialised rendering software to perform high-precision rendering, adjusting parameters such as lighting, colour, and materials to enhance realism and detail before exporting the animation.Following output, creators incorporate auditory elements—such as character dialogue, ambient sound effects, and musical scores—to heighten viewer immersion and effectively convey emotional resonance through the animation. Finally, video and audio are meticulously synchronised to ensure flawless alignment, eliminating any audio-visual desynchronisation.

3.2 Challenges in 3D Animation Production

Traditional 3D animation production is complex and time-consuming, with each stage interdependent. This process presents challenges including prolonged creative refinement, extended production timelines, and high labour costs.

In traditional 3D animation production, the foremost challenge creators face is the protracted refinement of creative concepts. Whether in the initial conceptualisation phase or subsequent character, environment, and storyboard design, achieving a finalised version in one go is exceedingly rare. During the conceptual stage, creators must meticulously refine details from establishing the narrative framework and defining core character traits to planning the overall environment. Each element requires repeated discussion and scrutiny to ensure the concept is both novel and logically coherent.In practice, constant adjustments and revisions are often required, with initially conceived plans potentially being scrapped and restarted. This process frequently consumes weeks or even months. Take character design as an example: starting from initial sketches, creators may produce dozens or even hundreds of versions before gradually finalising a character's appearance, personality traits, and costume details.Achieving both charm and distinctiveness may necessitate repeated tweaks to eye size, hairstyles, and colour schemes, with each modification requiring redrawing – substantially increasing the time and effort invested in design.

Secondly, extended production timelines remain an unavoidable challenge in traditional 3D animation. Creating 3D models is notoriously time-consuming, requiring creators to build numerous models—including characters, architecture, terrain, and props—using 3D modelling software. Each model must then be meticulously assigned texture maps and lighting settings, a process demanding

considerable time and effort.The animation production phase is equally demanding. Creators must meticulously set keyframes for characters, objects, and cameras frame by frame to ensure fluid, natural movement. For longer animations, this entails managing vast quantities of keyframes, each requiring careful, precise adjustments with zero margin for error.The post-production rendering stage is particularly time-consuming and labour-intensive. Creators must render each frame with high precision, repeatedly tweaking various parameters to achieve optimal visual results. This process demands substantial computational resources; rendering a single frame can sometimes take several hours or even days. Overall, producing a high-quality 3D animation from initial concept to final completion represents a significant investment of time for creators.

Moreover, high labour costs represent a significant challenge for traditional 3D animation production. The complexity and specialisation of 3D animation necessitate collaboration among numerous skilled professionals.A complete 3D animation production team typically comprises multiple roles, including concept artists, animation designers, modellers, renderers, editors, and sound designers. Professionals in these positions must not only master relevant software tools and techniques but also possess strong artistic sensibilities and creative abilities. This inevitably drives up the overall labour costs of animation production. For instance, animation designers require a solid grasp of animation principles to create imaginative and expressive characters and settings; modellers must be adept at 3D modelling software to construct intricate models with precision; renderers need mastery of rendering techniques to achieve desired effects through parameter adjustments; and sound designers must meticulously match audio and music to the animation's scenes and narrative.

4. Pathways for AIGC Technology to Empower 3D Animation Creation

In response to the aforementioned challenges in 3D animation production, AIGC technology presents new opportunities for industry advancement through its formidable generative capabilities, high processing efficiency, and cost-effectiveness. This technology can be integrated into every stage of 3D animation creation, optimising workflows through automation and intelligent processes. It not only provides creators with innovative approaches and methodologies but also significantly enhances production efficiency while reducing creative costs.

4.1 Pre-production Planning Phase: Stimulating Creativity and Enhancing Efficiency

During the pre-production planning phase, AIGC technology primarily supports creative conceptualisation, scriptwriting, character design, scene design, and storyboard development. It enables creators to rapidly generate numerous creative proposals, thereby shortening the initial planning timeline.

4.1.1 Creative Conceptualisation and Scriptwriting

AIGC technology can rapidly generate numerous creative ideas based on user-input keywords, thematic directions, or reference cases. For instance, a creator might input "fantasy-style 3D animation featuring a young swordsman protagonist with the core theme of defending one's homeland." AIGC tools can

then produce several distinct story outlines, core conflict settings, and audience analysis reports.While these generated proposals still require human screening and refinement, they provide creators with abundant creative inspiration, preventing creative block or exhaustion. Simultaneously, AIGC analyses elements from popular market works and audience preferences, offering data-driven support for creative proposals. This ensures works better align with market demands and resonate more readily with audiences.

4.2.2 Character and Scene Design

Regarding character design, AIGC tools can rapidly generate multiple draft designs based on the creator's provided character traits, physical descriptions, or stylistic references. For instance, inputting "a charming cartoon girl character, lively and energetic, wearing traditional Hanfu in bright, vibrant colours" enables AIGC to produce dozens of distinct character sketches within moments, encompassing varied hairstyles, clothing details, and poses.Creators can then refine and optimise these sketches rather than starting from scratch, significantly reducing time investment. For instance, the production team behind Reunion Order used the giant pandas Tuantuan and Yuanyuan as inspiration. Inputting keywords like "good-natured panda, ink-wash texture" prompted the AI platform to swiftly generate 20 design proposals.In scene design, AIGC proves equally potent. Inputting descriptions like "a bustling metropolis at night, illuminated by lanterns, with a river flowing through its heart" enables AIGC to generate multiple conceptual renderings showcasing varied compositions, lighting effects, and architectural styles. These provide clear references for subsequent scene modelling, allowing modellers to more accurately capture the overall aesthetic.For instance, the team behind the animated film The Beast employed Midjourney to rapidly generate multiple scene concept artworks, providing compositional and lighting references that significantly accelerated modelling efficiency and substantially shortened the production cycle.

4.3 Storyboard Design

Traditional storyboard design requires animators to draw frame by frame, a time-consuming and laborious process.AIGC technology can directly convert script content into visual storyboard sketches. Based on scene descriptions, character actions, and dialogue within the script, it automatically generates corresponding storyboard frames, complete with annotations for camera angles, movement patterns, and duration. For instance, inputting a script segment like "The protagonist pushes open the door, enters a dimly lit room, and discovers a glowing box in the corner" into an AIGC tool can generate several sets of storyboard sketches in different styles.Creators can then select suitable storyboard proposals based on their requirements, before refining and adjusting them. Certain AIGC tools can swiftly transform static storyboards into basic animated storyboard videos, simulating camera movements and scene transitions to help creators better grasp the pacing of their animated narratives in advance.

4.2 Mid-Production Phase: Automated Generation to Reduce Costs

The mid-production phase represents the most time-consuming and labour-intensive stage in 3D

animation creation. AIGC technology finds extensive application in areas such as modelling and material/texture creation. Through automated generation and production assistance, it can significantly enhance production efficiency.

4.2.1 Model Creation

3D modelling forms the foundation of mid-production. Traditional modelling methods require artists to spend considerable time crafting intricate details, making the process highly time-consuming.AIGC technology assists modelling in two ways: firstly, generating 3D models from 2D design drafts. By importing 2D character or scene designs into AIGC modelling tools, the software automatically recognises contours and structures within the image to produce a foundational 3D model. Modellers then refine details and adjust structures upon this base.The second method involves generating 3D models from textual descriptions. For instance, inputting "a circular wooden dining table with natural wood grain on the tabletop and four square legs" enables the AIGC tool to rapidly produce a table model meeting these specifications.

4.2.2. Material and Texture Creation

AIGC technology enables intelligent matching and rapid generation in material and texture creation. Firstly, it automatically recommends suitable material parameters based on a model's type and style. For instance, it assigns high-reflectivity, high-hardness properties to metallic models to achieve a metallic finish, or soft, low-reflectivity attributes to fabric models to convey a cloth-like suppleness.Concurrently, AIGC generates high-quality texture patterns from textual descriptions or reference images. Inputting prompts like "weathered brick wall texture with moss and cracks" or "leather texture featuring natural creases and sheen" yields corresponding texture maps.These texture maps not only boast rich detail but also automatically adapt to the model's shape, eliminating the need for manual painting and adjustment by texture artists and significantly reducing workload.

4.3 Post-production Compositing Stage: Intelligent Optimisation for Enhanced Quality

The post-production compositing stage is crucial for integrating all creative elements and refining the final outcome. AIGC technology provides robust support in post-production compositing, sound effects, and soundtrack creation, enhancing both the visual and auditory quality of the work.

4.3.1 Post-Production Compositing

During post-production compositing, AIGC enables intelligent colour grading and image restoration. Intelligent colour grading automatically adjusts parameters such as colour, contrast, and brightness according to the animation's style and scene requirements, ensuring consistent tonal harmony throughout the production. For instance, in traditional Chinese-style animations, AIGC automatically applies elegant, rich colour palettes; for sci-fi animations, it employs cool tones and high saturation to unify the visual aesthetic.Additionally, AIGC supports colour grading based on reference imagery. Creators need only import desired tonal reference images, and the tool automatically adjusts the footage to match the specified stylistic palette, eliminating the need for manual, pixel-by-pixel adjustments. For instance, the sci-fi animation The Metis employed AI tools like IC-Light for stylised

visual production, significantly boosting workflow efficiency.

Regarding image restoration, AIGC can automatically detect and rectify minor imperfections such as model clipping, abnormal lighting effects, or image noise, eliminating the need for manual, time-consuming corrections by compositors and reducing workload.Furthermore, AIGC enables intelligent image segmentation and rapid integration of elements from disparate scenes, boosting compositing efficiency. Take the original footage of the animated series The Legend of the Eight Immortals, which was riddled with noise and blurred details. Manual restoration would have been immensely challenging, whereas AIGC technology swiftly resolved these issues.

4.3.2 Sound Effects and Music Production

AIGC demonstrates formidable capabilities in sound effects and soundtrack production. For sound effects, creators need only describe actions and scenes in text for AIGC to automatically generate corresponding audio—such as footsteps, clanging collisions, or ambient noise.For soundtrack creation, AIGC generates original background music tailored to an animation's theme, emotional tone, and scene rhythm.Creators need only input specifications such as "warm, cheerful light music suitable for children's animation scenes" for AIGC to generate multiple tracks meeting the requirements, allowing creators to select and modify them. For instance, Shanghai BesTV's first purely AI-assisted animated production, Forest Fairy Tales, relied entirely on AIGC technology from character design to scene rendering, with its soundtrack and sound effects also intelligently generated.

5. Conclusion

The rapid advancement of AIGC technology has ushered in unprecedented transformation within the 3D animation industry. With its ability to produce content both swiftly and effectively, it has permeated every stage of 3D animation creation. This technology offers solutions to persistent challenges in 3D animation production, such as protracted creative refinement, extended production timelines, and high labour costs.During the initial planning phase, AIGC technology assists creators in rapidly generating concepts, offering diverse design proposals and storyboard ideas, thereby streamlining the planning process.During the mid-production phase, AIGC technology can automatically generate foundational 3D models and material textures, eliminating repetitive groundwork and making production readily achievable. In the post-production compositing stage, AIGC technology further enhances efficiency by intelligently adjusting colours, repairing minor visual imperfections, and integrating sound effects and music. This not only elevates the final output's quality but also significantly boosts creative productivity.

However, while AIGC technology offers convenience for 3D animation creation, it currently presents certain limitations. Firstly, the creative outputs generated by AIGC rely entirely on pre-trained data; it lacks genuine creative capacity and cannot convey deeper emotional layers. For animations requiring profound emotional depth or unique artistic styles, human creators remain indispensable for directional control, with AIGC serving only as an auxiliary tool.Secondly, outputs from AIGC technology may

exhibit minor flaws, such as structural inconsistencies in models or insufficiently refined repairs. These require subsequent adjustment and optimisation by creators to achieve the desired effect.

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