

Harmonizing Control and Creativity with AI for Animator's Toolkit

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Abstract— This study looks into the nuanced interaction between AI-driven autonomy and animator control within digital animation, a domain witnessing rapid technological advancements. Focusing on the AI-rendering techniques demonstrated in the works of Mick Mahler, with his explicit permission, we explore the balance of creative expression and automated efficiency in producing high-quality animations. The research critically evaluates the effectiveness and artistic fidelity of AI-assisted processes in animation, using Mahler's innovative methods as a case study. It proposes a novel framework for incorporating AI in animation workflows, emphasizing enhancement of the animator's creative agency. The methodology includes a qualitative analysis of animations rendered with AI, a quantitative comparison to traditional methods, and experimental application of the proposed framework in animation projects. By bridging the gap between the technical prowess of AI and the creative vision of animators, this study seeks to enrich the toolkit of digital animators, fostering a collaborative relationship between advanced technology and artistic creativity.

Keywords—AI, animation, rendering, stable diffusion

I. INTRODUCTION

The rapidly evolving domain of digital animation is currently experiencing a transformative phase with the introduction of artificial intelligence (AI) [1, 2]. This shift is revolutionizing the way visual narratives are conceived and perceived. This paper looks into the innovative incorporation of AI in the animation rendering process, a technique that holds the potential to redefine the boundaries of creative expression and technical efficiency in digital media. The motivation for this exploration is rooted in the trailblazing work of Mick Mahler [3], whose AI-driven rendering methods provide an intriguing peek into the future of animation. Within the sphere of digital animation, the relentless pursuit of more efficient, versatile, and quality-centric rendering techniques is well recognized. Conventional methods, while sturdy, often wrestle with limitations in terms of time [4], resource allocation, and flexibility in stylistic adaptation. AI, with its prowess for swift processing and adaptability, offers an appealing resolution to these challenges. However, the integration of AI into established animation workflows is not devoid of complexities [5, 6]. It demands a delicate equilibrium between the creative independence of the animator and the algorithmic accuracy of AI. This research,

therefore, aspires to articulate and scrutinize this equilibrium, positioning Mahler's methodology as a case study. In this investigation, we aim to look into the intricacies of creating 3D scenes in Blender, from the initial stages to the final render using AI-driven techniques. Our objective is to explore the seamless integration of AI into the animator's creative process, as well as the challenges and limitations that must be addressed in order to realize its full potential. The core principle of our investigation revolves around the effectiveness, artistic integrity, and practical applicability of AI in animation rendering. By carefully analyzing these factors, this research aims to provide a comprehensive understanding of the field, potentially opening up new opportunities for animators and technologists.

In this investigation, we aim to explore the efficacy of AI-rendering methods versus traditional techniques in digital animation. To achieve this objective, we propose a framework that seamlessly integrates AI into the animator's creative control, and investigate the broader implications of this synergy in digital media design and animation. This paper is poised to offer in-depth analysis and practical recommendations for future applications in digital media design and animation.

II. AI-DRIVEN ANIMATION METHOD

A. Overview of AI Rendering Tools

In the rapidly evolving landscape of digital animation, AI rendering tools stand as pivotal change agents [1]. Blender, an open-source 3D creation suite, serves as a foundational platform, offering robust features for modeling, animation, and rendering [7, 8]. The integration of AI into Blender transforms the conventional rendering process, introducing efficiency and versatility. Stable Diffusion [9], another significant tool, exemplifies the potential of AI in rendering, enabling rapid, style-variant image generation. This section critically evaluates the capabilities and limitations of these tools, discussing how they revolutionize traditional animation workflows while also considering the computational demands and the required skill set for effective utilization.

B. Workflow Analysis

The integration of AI in digital animation has revolutionized the creative process, offering unparalleled

efficiency and accuracy. This section delves into the workflow of AI-driven animation, deconstructing each step to illustrate how traditional craftsmanship is seamlessly enhanced by AI technology. Key focus areas include the application of render passes such as depth and line art, which are crucial for AI's interpretation of the 3D space. This analysis not only highlights the streamlined efficiency achieved but also delves into the challenges and complexities involved, such as ensuring artistic intent is accurately translated by AI algorithms.

C. Mick Mahler's Method: A Case Study

Mick Mahler's innovative approach in AI-driven animation provides a practical and insightful example of this technology in action. His method, which bridges the gap between AI's algorithmic potential and the animator's creative vision, offers a unique perspective on the application of AI in rendering. This case study dissects Mahler's workflow, from initial scene setup to the final AI-enhanced output. The discussion critically assesses how Mahler's technique addresses common industry challenges, such as maintaining consistency across frames and balancing creative control with AI's autonomous capabilities. By analyzing this case study, this section aims to extrapolate broader lessons and best practices applicable to the field of AI-driven animation. In sum, this section of the paper provides an in-depth examination of the tools and techniques at the forefront of AI-driven animation, offering critical insights into their practical application and implications for the future of digital animation.

III. METHODOLOGY

This research employs a qualitative content analysis approach, focusing on a detailed examination of the transcript from Mick Mahler's presentation on AI-driven animation rendering. The methodology is structured as follows:

1. **Materials Analysis:** The primary source for this research is the AI animated video and workflow developed by Mick Mahler. This material will be analyzed in depth, extracting key themes, techniques, and insights related to AI-driven animation.
2. **Comparative Analysis:** The findings from Mahler's method will be compared with established practices in digital animation. This comparison aims to highlight the unique aspects and potential advantages of the AI-driven approach.
3. **Theoretical Framework Application:** The study will apply relevant theoretical frameworks from digital media, animation, and AI technology to contextualize and interpret the findings from the transcript. This application will help in understanding the broader implications of Mahler's approach.
4. **Synthesis and Interpretation:** The final step involves synthesizing the information gathered and interpreting it in the context of the current landscape of digital animation and AI. This synthesis will form the basis for the discussion on the effectiveness, challenges, and future potential of AI in animation, as illustrated by Mahler's work.

This methodology allows for a comprehensive understanding of the AI-driven animation process as demonstrated in the transcript, facilitating an insightful analysis that is rooted in theory yet closely aligned with practical, real-world applications.

IV. RESULTS

A. The process

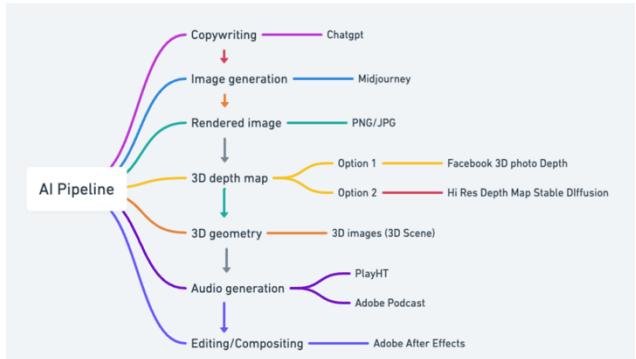
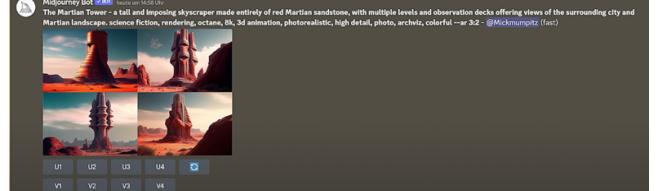
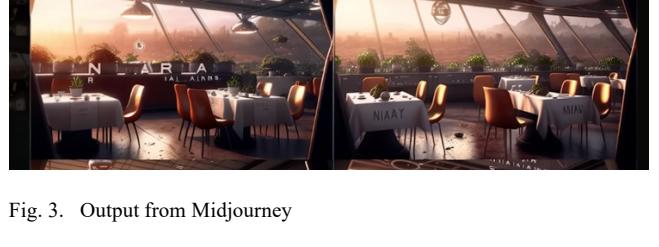
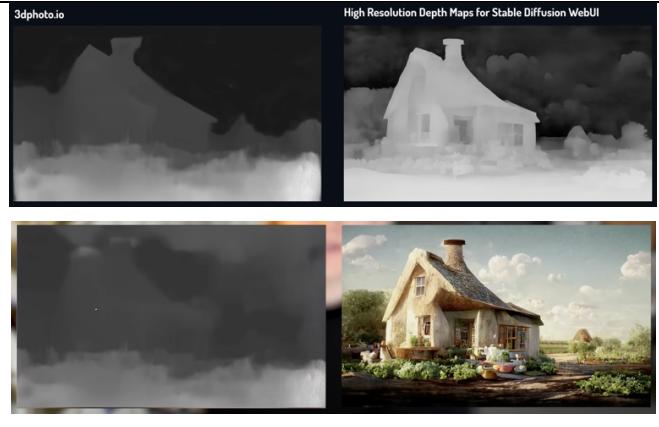
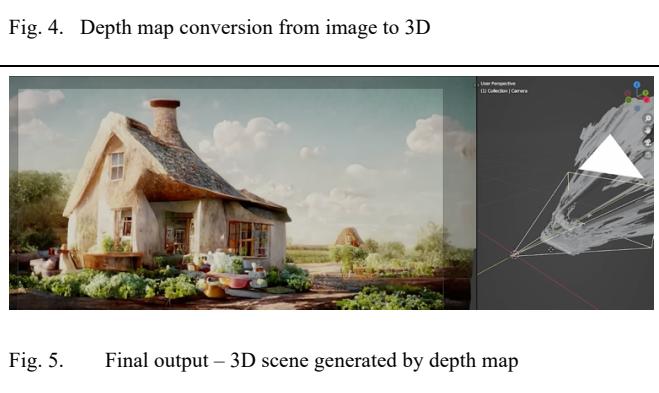
Before we delve into the result of this study, we extracted the process involved and illustrated in Table 1 below. The depicted AI pipeline illustrates a creative process leveraging various AI tools to produce multimedia content. Initially, AI such as ChatGPT is used for copywriting [10], generating textual content based on specific prompts or data. The process then moves on to image generation, utilizing AI software like Midjourney to create visual elements [11]. These images, typically saved in PNG or JPG formats, are then processed to create a 3D depth map [12], offering two options: using Facebook 3D photo depth [13] for a standard mapping or a high-resolution depth map with Stable Diffusion for enhanced detail.

Once the depth map is completed, marking a significant transition from two-dimensional imagery to a three-dimensional environment, we proceed to the construction of 3D geometry. This stage is not merely about translating the 2D images; it's about giving them depth and volume, effectively transforming static visuals into dynamic entities that can inhabit a 3D space. This process breathes life into the images, allowing them to interact with each other and their environment in a way that was not possible in the 2D realm. In parallel to this, AI tools such as PlayHT are employed to generate audio content. This could be in the form of narration that guides the viewer through the experience, or character dialogue that adds a layer of interactivity and engagement to the content. The use of AI in this stage allows for a level of customization and personalization that would be difficult to achieve manually.

Adobe Podcast may also be used for audio processing and refinement. This ensures that every sound byte is crisp, clear, and contributes effectively to the overall sensory experience. It's not just about having sound; it's about having the right sound at the right time, enhancing the immersion and realism of the content. Finally, all the assets come together in the editing and compositing stage. Software like Adobe After Effects is used to integrate the visual and audio elements, creating the final multimedia product. This stage is where the magic happens, as disparate elements are synthesized into a cohesive whole. It's here that concepts become tangible experiences, and all the previous steps coalesce into a symphony of media elements, orchestrated with precision by AI.

This streamlined AI-driven pipeline signifies more than just the synergy between multiple technologies; it represents a paradigm shift in content creation processes. It's not just about making things easier or more efficient; it's about pushing the boundaries of what's possible, innovating new forms of expression, and redefining the very nature of creativity. By leveraging the power of AI, we can chart a course towards a future where technology and creativity are inextricably linked, driving us towards new horizons of artistic and technological innovation.

TABLE I. AI PIPELINE AND PROCESS INVOLVED

 <pre> graph TD AI[AI Pipeline] --> CG[Copywriting - ChatGPT] AI --> IG[Image generation - Midjourney] AI --> 3D[3D depth map] AI --> 3Dgeo[3D geometry] AI --> AG[Audio generation - PlayHT] AI --> EC[Editing/Compositing - Adobe After Effects] CG --> CG_out[ChatGPT output] IG --> IG_out[Midjourney output] 3D --> 3D_out[3D depth map outputs] 3Dgeo --> 3Dgeo_out[3D geometry outputs] AG --> AG_out[PlayHT output] EC --> EC_out[Adobe After Effects output] </pre>	<p>M: You are a copywriter for a travel company that offers trips to distant planets and galaxies. AI: Sure, how can I help you with your copywriting needs? Do you have a specific message or theme you would like me to convey in the copy? M: Write a text promoting the city on Mars as a travel destination. Include the sights and special attractions of the city and recommend the best restaurants. AI: Are you ready for an out-of-this-world adventure? Look no further than the city on Mars! This futuristic metropolis offers travelers the unique opportunity to experience life on another planet. One of the top sights to see is the Martian Space Center, where you can learn about the history of space exploration and see exhibits on the technology used for the first human mission to Mars. The city also boasts stunning architecture, including the towering Martian Tower, a skyscraper made entirely of red Martian sandstone. For outdoor enthusiasts, the Martian Landscapes National Park offers breathtaking views of the planet's rugged terrain and unique rock formations. Take a hike or take a ...</p>
	<p>Fig. 1. Chatgpt for script generation</p> 
	<p>Fig. 2. Midjourney for image generation</p> 
	<p>Fig. 3. Output from Midjourney</p> 
	<p>Fig. 4. Depth map conversion from image to 3D</p> 
	<p>Fig. 5. Final output – 3D scene generated by depth map</p> 

B. AI Rendering Tools and Techniques:

The exploration of AI rendering tools and techniques, as derived from the study, reveals a significant advancement in the animation field, brought about by AI technologies like Blender and Stable Diffusion. These tools are reshaping traditional animation approaches, offering enhanced flexibility and efficiency.

TABLE II. DETAILED BREAKDOWN OF AI VS. TRADITIONAL ANIMATION

Feature	Traditional Animation Tools	AI Tools (Blender, Stable Diffusion)
Rendering Speed	Typically slower due to manual processes and hardware limitations.	Significantly faster, leveraging AI algorithms for rapid rendering.
Style Adaptability	Limited; often requires manual adjustments for different styles.	Highly adaptable; capable of rendering in various styles through AI algorithms.
User Control	Detailed control over every aspect of animation but can be time-consuming.	Balances control with AI automation, enhancing efficiency without significant loss of creative input.
Computational Requirements	Varies, but generally lower compared to advanced AI tools.	Higher due to AI processing; requires more powerful hardware for optimal performance.
Learning Curve	Steep, particularly for complex animation software.	Also steep, compounded by the need to understand AI-driven processes.
Consistency Across Frames	Achieved through meticulous manual effort.	AI tools offer improved consistency, especially in complex scenes, using render passes for depth and line art.
Customization	High level of customization through manual methods.	Enhanced customization through AI's ability to interpret and apply various artistic styles automatically.

This table clearly illustrates the evolution of animation tools from traditional methods to AI-driven approaches. The AI tools, particularly those demonstrated in Mahler's presentation, are not merely efficient alternatives; they redefine the realm of animation by allowing enhanced control over artistic styles. This evolution addresses significant challenges in traditional animation, like labor-intensive rendering and stylistic inflexibility, opening new avenues for creativity and efficiency. Such a comparison not only highlights the technological advancements in AI tools but also sheds light on their potential to transform digital animation practices.

C. AI Driven animation workflow

The AI-driven animation rendering process, as elucidated in the provided flowchart, begins with the essential phase of 3D Scene Creation in Blender. This foundation is where the virtual environment takes form, influenced by the animator's artistic vision and technical prowess. Following this initial creation, the workflow transitions to the pivotal Step 1: the application of Render Passes. In this stage, depth and line art passes are meticulously applied, serving as critical layers that will guide the subsequent AI interpretation and rendering, ensuring that the animation adheres to the intended stylistic nuances and spatial dynamics. Advancing to Step 2, the processed scene is then imported into Comi, a node-based interface that acts as the conduit for Stable Diffusion's AI algorithms. This interface is pivotal in translating the scene's

complexity into directives that the AI can comprehend and act upon, marrying technical data with creative intent. The culmination of this workflow is witnessed in Step 3, AI-Driven Rendering with Stable Diffusion. Here, the AI leverages the preparatory work done in the previous steps to render the final animation. This stage is where the speed and efficiency of AI rendering are most evident, transforming the blend of initial 3D elements and subsequent layering into a cohesive, visually arresting animation.

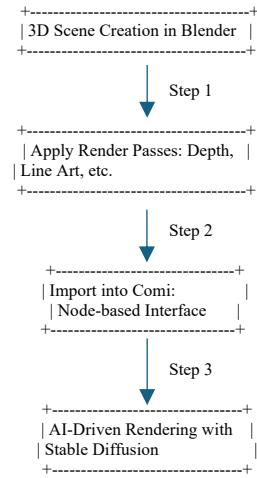


Fig. 6. Sequential Process for AI-Enhanced 3D Rendering in Blender

This flowchart embodies a clear and systematic visualization of the AI-driven animation process, highlighting the sequential nature of this innovative approach. It not only serves to inform but also emphasizes the contributions of each phase, stressing the enhancement of efficiency and creative flexibility that AI brings to the field of animation.

D. Analysis of Mick Mahler's Method

In the domain of digital animation, the utilization of AI-driven methods, as exemplified by Mick Mahler's technique, marks a significant leap forward. Illustrative visual charts could effectively represent Mahler's workflow, providing a step-by-step elucidation of the process. Such charts or comparative images offer a tangible depiction of the workflow's evolution from scene creation to final rendering, thereby facilitating a deeper understanding of the AI-driven animation process.

E. Pros and Cons of Mahler's AI Animation Method:

To critically evaluate the efficacy and implications of Mahler's AI-driven method, a comparison table is constructed, outlining the advantages and challenges inherent to this approach.

Pros of Mahler's AI Animation Method:

- Increased Efficiency:** AI significantly reduces the time required for rendering, accelerating the production cycle.
- Enhanced Creativity:** Artists can experiment with styles and aesthetics that AI can generate, pushing the boundaries of traditional animation.

3. **Consistency:** AI can maintain uniformity across frames, especially important for complex sequences, ensuring a cohesive final product.
4. **Customization:** AI's ability to process individual elements with specific prompts allows for detailed customization at a granular level.
5. **Technical Innovation:** Mahler's method reflects a cutting-edge use of technology, positioning artists at the forefront of the digital animation industry.

Cons of Mahler's AI Animation Method:

1. **Technical Barriers:** The need for sophisticated hardware and an understanding of AI processes can be a barrier for some animators.
2. **Over-Reliance on AI:** There's a potential for artists to become overly reliant on AI, possibly stifling the development of traditional animation skills.
3. **Unpredictability:** AI can sometimes yield unexpected results, which may not always align with the animator's vision.
4. **Loss of Fine Control:** While AI offers granular control, it may not match the level of detail that hands-on animation can achieve.
5. **Initial Learning Curve:** Animators need to invest time to master the new workflow, which integrates complex AI-driven tools.

Each aspect within this table is dissected, juxtaposing the efficiencies and creative liberties against the technical and adaptational challenges posed by the AI methodology. For instance, while the AI approach accelerates the rendering process, it also introduces a learning curve that

demands animators adapt their skills to harness the full potential of AI tools.

The visual chart of Mahler's method, alongside the comparative table, serves as a scholarly tool for dissecting the intricate balance between the advanced capabilities afforded by AI and the creative and technical acumen required from animators. This dual presentation enriches the discourse on AI in animation, presenting Mahler's approach as an exemplar of the synergy between technology and artistry in contemporary digital media creation.

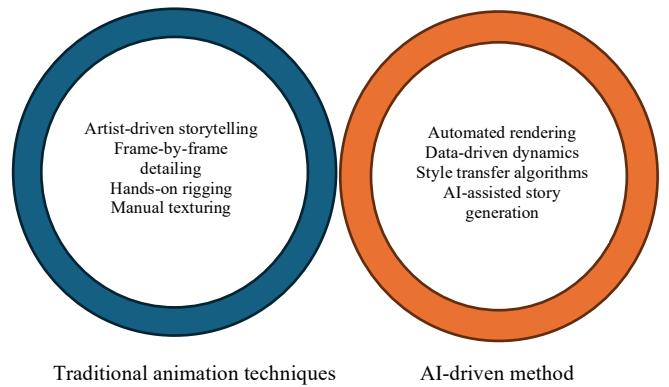


Fig. 7. Venn Diagram of traditional and AI-driven animation methods

Table 3 explores the distinct processes, theories, technical requirements, learning curve, cost and target audience of each approach (Table 2). This analysis sheds light on the evolving animation landscape, particularly how AI integration impacts traditional workflows. We examine not only the practical differences but also the broader implications for creativity, authorship, and technological innovation in animation.

TABLE III. AI-DRIVEN ANIMATION VS CONVENTIONAL ANIMATION

Aspect	AI-Driven Animation Techniques	Conventional Animation Methods
Process	<ul style="list-style-type: none"> * Utilizes AI algorithms to automate rendering, texturing, and animation processes. * Offers streamlined workflows, reducing production time and enabling experimentation with diverse styles. * Provides granular control over individual elements within animation (e.g., lighting, character movement). * Supports real-time rendering capabilities, allowing for immediate feedback and adjustments. * May involve pre-trained models for image generation, requiring customization and fine-tuning for specific animation needs. 	<ul style="list-style-type: none"> * Relies on manual labor for rendering, texturing, and animation, requiring meticulous frame-by-frame creation. * Offers a high degree of artistic control over every aspect of animation. * Animation speed is limited by the animator's skill and experience. * Real-time rendering can be challenging, often requiring pre-rendering for complex animations. * May incorporate traditional animation principles like squash and stretch, timing, and anticipation for a more natural and expressive look.
Theory	<ul style="list-style-type: none"> * Integrates AI principles and algorithms into animation workflows. * Embraces machine learning and deep learning techniques for image generation, allowing for the creation of complex and dynamic visuals. * Explores the intersection of art and technology, blurring the lines between human creativity and machine-generated content. * Challenges traditional notions of authorship and artistic control, raising questions about who is the "creator" in AI-assisted animation. * Expands the concept of creativity through collaboration with AI systems, where human artists guide and refine AI-generated outputs. 	<ul style="list-style-type: none"> * Rooted in traditional animation principles like squash and stretch, timing, and anticipation, ensuring a sense of weight, fluidity, and anticipation in the animation. * Relies on the animator's expertise and intuition for character development, storytelling, and emotional conveyance. * Emphasizes the importance of hand-drawn or computer-assisted animation techniques, valuing the artistic expression and craftsmanship inherent in traditional methods. * Celebrates the unique skill set and artistry of animators, recognizing the dedication and talent required to create high-quality animation.

Technical Aspect	<ul style="list-style-type: none"> * Requires access to AI-driven tools and software platforms, such as Blender, Stable Diffusion, or proprietary AI algorithms developed by animation studios. * Demands a certain level of technical proficiency in using AI tools and understanding basic AI concepts to effectively harness their capabilities. * Involves processing power and hardware compatibility for efficient rendering, particularly for complex AI-generated animations. * May involve training AI models or adapting pre-existing models for specific animation tasks, requiring additional time and expertise. * Faces challenges related to data privacy (e.g., ensuring the security of training data), bias (mitigating potential biases in AI-generated content), and ethical considerations regarding ownership and authorship of AI-created elements. 	<ul style="list-style-type: none"> * Relies on animation software specifically designed for 2D or 3D animation, such as Adobe Animate, Toon Boom Harmony, or Maya for 3D animation. * Requires proficiency in animation software and techniques, including traditional hand-drawn skills or computer animation skills depending on the chosen method. * Utilizes computer hardware for animation rendering and processing, with the processing power needs varying depending on the complexity of the animation. * Incorporates manual labor and artistic skill in creating animations, emphasizing the role of the animator in shaping the final product. * Faces limitations in achieving highly complex animations or real-time rendering capabilities compared to AI-driven methods, which can automate complex tasks and generate visuals in real-time.
Learning Curve	<ul style="list-style-type: none"> * Steeper learning curve due to the need to understand AI tools, concepts, and potentially train AI models. 	<ul style="list-style-type: none"> * Moderate learning curve depending on the chosen animation method. Traditional hand-drawn animation has a lower barrier to entry, while 3D animation requires mastering specific software.
Cost	<ul style="list-style-type: none"> * Cost can vary depending on the software licenses and processing power required. Open-source AI tools might be available, but some features might be limited compared to commercial offerings. 	<ul style="list-style-type: none"> * Cost can vary depending on the software licenses needed. Traditional hand-drawn animation can be more cost-effective for simpler projects, while 3D animation software tends to have higher licensing costs.
Target Audience	<ul style="list-style-type: none"> * Suitable for studios and animators seeking to streamline workflows, experiment with new styles, and achieve complex animations. 	<ul style="list-style-type: none"> * Suitable for a wide range of projects, from independent animation to large-scale studio productions. Traditional methods offer more artistic control and a distinct visual style.

F. Synthesis of AI Animation's Potential

Key Benefits of AI in Animation:

AI in animation offers several advantages. Firstly, it enhances efficiency by streamlining the animation process, leading to reduced production time and costs. Additionally, it fosters creativity by empowering artists to explore diverse styles and experiment with new visual aesthetics. Furthermore, AI ensures consistency across frames, maintaining visual coherence in complex sequences. Moreover, it enables precise control over individual elements, facilitating tailored artistic expressions. Lastly, AI drives technological innovation, pushing the boundaries of animation possibilities.

Challenges in AI Animation:

However, the integration of AI in animation comes with its challenges. There are technical barriers that require specialized knowledge and resources, potentially excluding some animators from adopting these tools. Additionally, there's a risk of over-reliance on AI, which could hinder the development of traditional animation skills. Furthermore, AI-generated outputs may sometimes diverge from the artist's vision, leading to unexpected results. Moreover, while offering granular control, AI may lack the finesse of manual animation techniques. Lastly, artists need time to adapt to new workflows and integrate AI-driven tools effectively, indicating a steep learning curve.

Future Potential of AI in Animation:

Looking ahead, the future potential of AI in animation is promising. Advancements in AI could facilitate enhanced collaboration between artists and algorithms, fostering new creative synergies. Moreover, AI-driven rendering may lead to real-time animation production [5], revolutionizing workflows. Additionally, AI's narrative generation capabilities could open avenues for dynamic storytelling in animation. However, it's crucial to address ethical considerations and ensure responsible AI use in animation to navigate potential challenges associated with AI integration [14].

V. CONCLUSIONS

Our exploration into the realm of AI-driven animation has unveiled a terrain abundant with innovation, challenges, and significant transformative potential. The analysis has shed light on the primary advantages of incorporating AI into animation workflows. AI simplifies production processes, bolsters creativity by facilitating experimentation with a variety of styles, ensures uniformity across frames, and propels technological advancements. However, this journey has also exposed challenges such as technical obstacles, the risk of excessive dependence on AI, and the unpredictability of AI-generated outputs.

Despite these hurdles, the future of AI in animation is filled with immense promise. Progress in AI technology stands on the brink of revolutionizing the animation industry, fostering enhanced collaboration between artists and algorithms, enabling real-time rendering capabilities, and offering dynamic storytelling possibilities. As we traverse this frontier, it becomes crucial to address ethical considerations and advocate for responsible AI usage to fully harness its potential. Our discourse has emphasized the pivotal role of AI in shaping the future of animation. By utilizing AI-driven tools and techniques, artists can unlock unprecedented creative possibilities, push the boundaries of traditional animation, and deliver mesmerizing visual experiences to audiences worldwide.

As we welcome this paradigm shift, it is essential to acknowledge AI as a formidable ally in the pursuit of artistic excellence and innovation. In conclusion, our exploration of AI-driven animation has not only illuminated the current landscape but also charted a path for future research and development. By embracing AI's transformative potential and addressing the associated challenges, we can navigate towards a new era of animation that is both technologically advanced and artistically enriching.

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