Utilization of Artificial Intelligence for 3D Production Process

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Abstract—Computer technology has integrated with Artificial intelligence (AI) and has brought a great improvement in the modern era. Nowadays, AI is widely applied in all industries. The 3D technology has undergone a radical transformation. Since AI has transformed 2D into 3D, Researchers have analyzed how AI is useful in 3D and maintains its workflow in this research paper. Every 3D department, such as Modeling, Texturing, Rigging, Animation, Lighting and Rendering, uses AI. A survey has been conducted among the experts in this field to determine its value. Results have demonstrated that AI has improved 3D quality in the shortest amount of time. This research work has been showing that most of the respondents are fond of using AI in the 3D production process.

Keywords—Artificial Intelligence, 3D, 3D pipeline, Motion Capture, Animation

I. INTRODUCTION

In the 3D world, there is a digital revolution driven by AI (Artificial Intelligence) and MI (Machine learning. A key component of animation production (pre-production, production, and post-production) is artificial intelligence and machine learning. As part of the animation process, artificial intelligence is being used to automate and simplify some processes, such as modelling, texturing, rigging, animation, and rendering, for characters and assistance with scene layouts and camera movements. [14]

It's not that old when researchers consider the history of AI and animation. However, when AI is combined with 3D technology, it transports us to a different universe. AI was first solely utilized for improvements, backgrounds, and other text-related elements. AI has slowly made significant progress, and it now extends far in front of us. The use of AI in film production began in the mid-2000s. AI and Machine Learning Algorithms are used to create 3D models of animals and are used in 3D films like Up, Good Dinosaur, etc. [5]

Figure 1 shows the Significant Advances in Artificial Intelligence Used in Animation Studios at the different steps in 3D Animation.
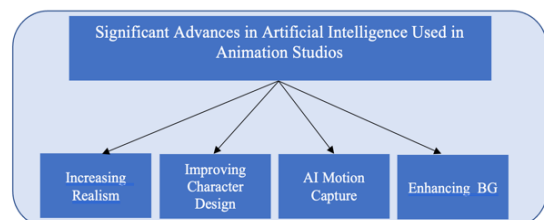

Fig. 1. Significant Advances in Artificial Intelligence Used in Animation Studios

A. Increasing Realism

AI technology has become more efficient in creating realistic 2D character illustrations and 3D models, texturing and animating those models with realistic body language, facial expressions, lip sync and so on. This has enhanced the performance of the characters and is used in various platforms like films, educational videos, advertisements, etc. [13] in production by reducing the complexity of keyframes and curves. Utilize techniques like motion tweening or interpolation to create smoother animations with fewer keyframes. Consider using sprite sheets or atlases to minimize the number of draw calls. Implement techniques like object pooling to reuse and manage animated objects efficiently. Lastly, use hardware acceleration and optimize rendering techniques to ensure smooth playback.

B. Improving Character Design

Artificial intelligence is now commonly used to generate distinctive and visually captivating 2D and 3D characters that meet the specific needs of a film. AI algorithms have become more efficient and generate enhanced quality 2D character illustrations and 3D character models for films and animated videos. [10]

AI focus on the character's purpose and personality, ensuring their visual design aligns with their narrative function. Create a distinct silhouette and proportions that are visually appealing and easily recognizable. Pay attention to details such as facial expressions, body language, and clothing to convey the character's traits effectively. Incorporate unique and memorable features that set the character apart while ensuring coherence and balance in the overall design. Continuously

iterate and seek feedback to refine and enhance the character's design.

C. AI Motion Capture

The motion capture technology integrated with AI has improved the realism in animated videos by capturing the physical movements of real-life characters from any video or camera and imitating those movements for the animated character to make more real-life-like animation with enhanced quality for higher audience engagement. [3]

D. Enhancing BG

Creating models like trees, mountains, clouds, buildings etc., are some essential aspects of generating environments for animated videos. AI technology has brought up a lot of enhanced background elements that can be combined together to make visually appealing and unique backgrounds for animated films. AI technology has made background creation more accessible and faster with enhanced quality. [2]

AI focuses on composition using techniques like leading lines and balanced arrangements to create visual interest. Consider the lighting and atmosphere to establish mood and add depth to the scene. Add intricate details and textures relevant to the environment to make it visually engaging. Ensure the background complements the foreground elements and reinforces the narrative or theme of the scene.

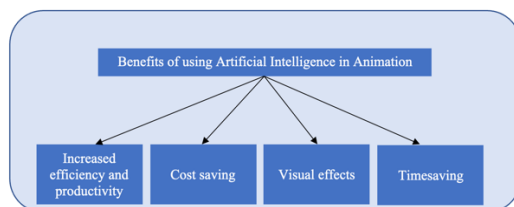Figure 2 shows the Benefits of using AI in Animation production.

Fig. 2.   Benefits of using AI in Animation

A. Increased efficiency and productivity

AI has enhanced the quality of animation by generating unique and more creative models. It has automated all the time-consuming tasks, and now it is easier for the animator to work on their films. Lengthy processes such as modelling, texturing, rigging etc., are done faster at a better quality. [17]

B. Cost saving

As AI has automated various time-consuming processes, animation studios can now do those tasks easily instead of employing various artists for each task. This has become more cost-saving for studios. presently, it is feasible for individuals to generate superior quality content with reduced expenses and time constraints. [9]

C. Visual effects

Visual effects stand for VFX. Visual effects are used in both live-action and animated films. There are lot of sub-departments in VFX such as Roto, Paint, Tracking and Match moving, Matte painting and Compositing. [11] AI technology has made the task of creating visual effects easier and faster for all kinds of films. AI generates high-quality visual effects that are unique, appealing and makes the shots look more realistic. The process of creating visual effects for films is automated by AI, which is also high in quality. [12]

D. Timesaving

Every process, such as modelling, texturing, rigging, lighting, and rendering, and animating videos, requires many artists and a lot of time to complete. AI algorithms have made such tasks to be completed in a few hours, which will be more beneficial for studios to engage in more projects that will be more profitable for the animation studios. [7]

II.   REVIEW OF LITERATURE

Animation packages partially automate action between critical frames. However, animators must hand-draw sequences with multiple interacting characters, and any mechanical behavior is hard-wired and lacks autonomy. "FreeWill" prototype overcomes these limits by designing and building an expandable cognitive architecture to accept goals, actions, and knowledge, giving animated avatars some degree of autonomous intelligent activity. [15]

Human–computer interaction based entirely on computer software operations cannot match human computer usage needs due to the fast growth of computer technology and artificial intelligence. People want a faster, more accessible human–computer interface. This work investigates deep learning-based expression dynamic capture and 3D animation production. This research provides a deep learning-based face feature extraction approach and SVM feature classification for facial emotion dynamic capture. C++ and OpenGL simulate 3D animation rendering. This paper's face identification technique performed well in accuracy and speed. Real-time video face detection is possible. [19]

This article covers the development of classic animated visuals using artificial intelligence in digital media. Classifying characters requires studying and summarizing animated pictures. Real-coded genetic algorithm generates many flexible components. It also optimizes the genetic strategy during operation and creates fitness functions based on the animated picture. Researchers create a diverse library of components by increasing generative population variety via NURBS curve shape change. The Authors can create several animation styles using automated assembly and component selection. [20]

Biometric video recognition technology is modern computer hardware and software. It recognizes persons by their facial features. Facial recognition's automated identification and subject-invisibility are its key benefits. 3D animation studies abound. Takahashi Y used predictive processing theory to explain how autism spectrum disorder affects facial emotion recognition. [16]

III. THE UTILIZATION OF AI WHEN IT COMES TO 3D PIPELINE

AI is used in 3D production to automate tasks like modeling, animation, texturing, lighting, and rendering. It can generate realistic 3D models, predict animations based on motion capture data, automate the texturing process, optimize lighting setups, and enhance the final output (Rendering) through post-processing techniques. AI accelerates production, improves quality, and streamlines workflows in the 3D production process.

Figure 3 demonstrates the utilization of AI in the 3D Animation Production Pipeline/ Production for 3D filmmaking.
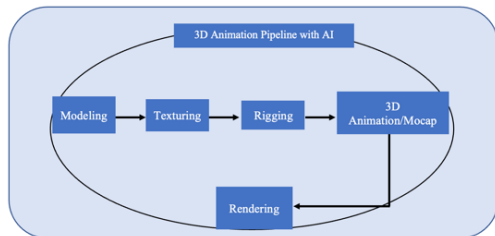

Fig. 3.   3D Animation Production Pipeline/ Production for 3D filmmaking

A. 3D modelling

3D models stand for organic and inorganic characters related to 4 types of methods such as Polygonal Modeling, NURBS Modeling, Sculpting, and Procedural Modeling. These are built using AI algorithms that can be more precise and lifelike than those made manually. This may result in more efficient and economical design systems. Similar to virtual reality or VHS games, AI is also being utilized to analyze and optimize 3D models for specific processes. [4]

B. 3D texturing

3D models are given shaders according to the materials and then coloured and textured. AI has many realistic textures for all kinds of materials that make model look more real-life-like and appealing. These textures are high in quality, the process is time-saving and high-quality output is generated. [18]

C. 3D rigging

3D rigging for characters are rigged automatically using AI algorithms that make it easier for the animators to animate the characters by giving them movements. AI technology creates joints at appropriate places and rigs the whole character automatically in a few minutes. [1][8] 3D rigging is the process of creating a digital skeleton, called a rig, that allows animators to manipulate and control a 3D model's movement and deformation. It involves setting up a hierarchical structure of interconnected bones, joints, and control mechanisms within 3D software.

In the animation modeling process, 3D rigging plays a crucial role. Rigging is the process of creating a digital skeleton or structure for a 3D model, allowing animators to manipulate and animate the model. It involves adding a system of joints, controls, and deformers to the model, which enables it to move realistically.

Figure 4 shows the 3D Rigging setup in Maya Software

Fig. 4.   Four Views of Rigging System in Maya

D. 3D animation through MOCP

3D animation related to movement and AI-integrated MOCP software captures high-fidelity movements and expressions of characters through high-quality videos or cameras. These are later used for imitations in animated videos, which makes them more realistic and automates the process at a faster pace. This technology can be used in animated films to create higher user engagement. [6] throw creating higher user engagement for animation, focusing on compelling storytelling, visually appealing animation, and emotional connection with relatable characters.

E. 3D Rendering

AI helps artists to render 2D images of their 3D models or environment at perfect angles and proper lighting. It renders quite accurate and life-like environments, models, and characters at a higher and enhanced quality within the minimum amount of time. [8]

Figure 5 shows that a 3d workspace is a combination is 3axies which consist of XYZ, YXZ or ZYX
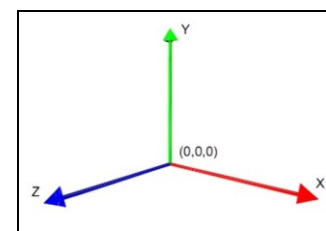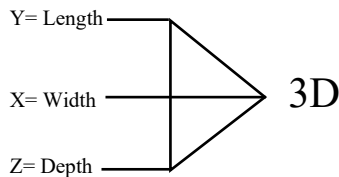
xyz= 3D

yxz= 3D

zyx=3D

Fig. 5.   Showing the 3D workspace system (x,yz)

3D workspace is vital for a 3D production without its shape will be considered as 2d surface

Y= Length

X= Width   3D

Z= Depth

3D software work on three dimensions of an object, namely X, Y and Z. There are both positive and negative axis and work accordingly. The X axis defines the width of an object, the Y axis defines the length of the object, and the Z axis defines the object's depth. Researchers can translate, scale, and rotate 3D model based on these dimensions only.

TABLE I.   AI + 3D ANIMATED MOVIES

Movie Name	Release Year	AI	3D
Beyond the Mind's Eye	2010	Yes	Yes
Data Dreamscapes	2016	Yes	Yes
AI's odyssey	2021	Yes	Yes

Q1: Do you agree that AI is Vital for the 3D Production Process?
Q2: Do you agree that the use of AI is Time saving tool for 3D production?
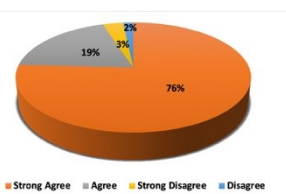Q3: Do you think that AI is the future of 3D production?
Q4: Do you think that 3D production can be worked without AI?
Q5: Do you agree that the use of AI scripts in 3D production is an easy process?
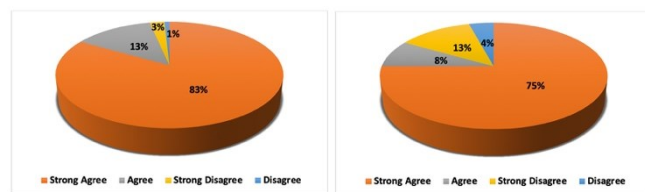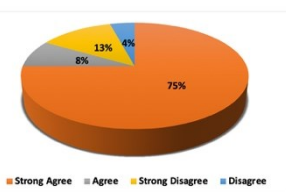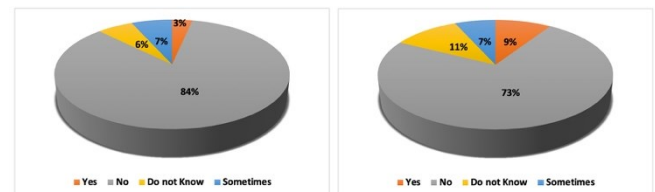Q6: Are you agree that AI increases the quality of 3D production?
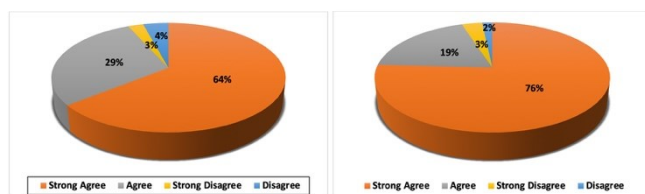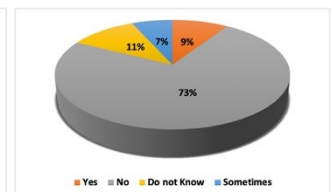

(a)   (b)

(c)   (d)

(e)   (f)

Fig. 6.   Showing the survey

IV. RESULTS SUMMARIZATION AND FINDINGS

In this section finding of survey has been presented. Overall, 93% agree that AI is essential for 3D production. In the contrast, 7% consider that AI is not Vital for 3D Production (Figure 5 (a)). It clears in figure 5 (b) that 95 % claim that AI is a time-saving technique or tool for 3D production where 5% are disagree. In figure 5 (c) 96% consider that AI is the future of the 3D production process, and 4% disagree with this question. Although Ai is Vital for 3D production but Figure 5 (d) 83% showing that 3D production can be worked without AI technology, and 17% are the opposite of this statement. Even though AI is a time-saving process but according to above figure 5 (e), 84 % say that Ai script is not easy to understand it too difficult and 3% thinking it is easy, and 6% don't know about it. In the last question, figure 5 (f), 73 % show that AI cannot increase the quality of any 3D film, whereas 11% don't know about it, and 9% say yes, it can increase the quality, but 7% sometimes.

V. CONCLUSION

An in-depth discussion of AI and 3D-production applications is included in this study. The artist who works in 3d Production can gain a lot of benefits from it. AI can be used in various parts of the 3d Production pipeline from pre-production and post-production, which can be used in various parts through which researchers can gain benefits. Gradually Ai is stepping into 3d production and spreading its wings. A survey has also been conducted in this study regarding 3d production and AI. It's found out that artists in the field of 3d production have started showing interest towards AI. And it's also proved that AI is the future of 3d Production.

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