The Development of Virtual Production in Film Industry in the Past Decade

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Suzhou, China
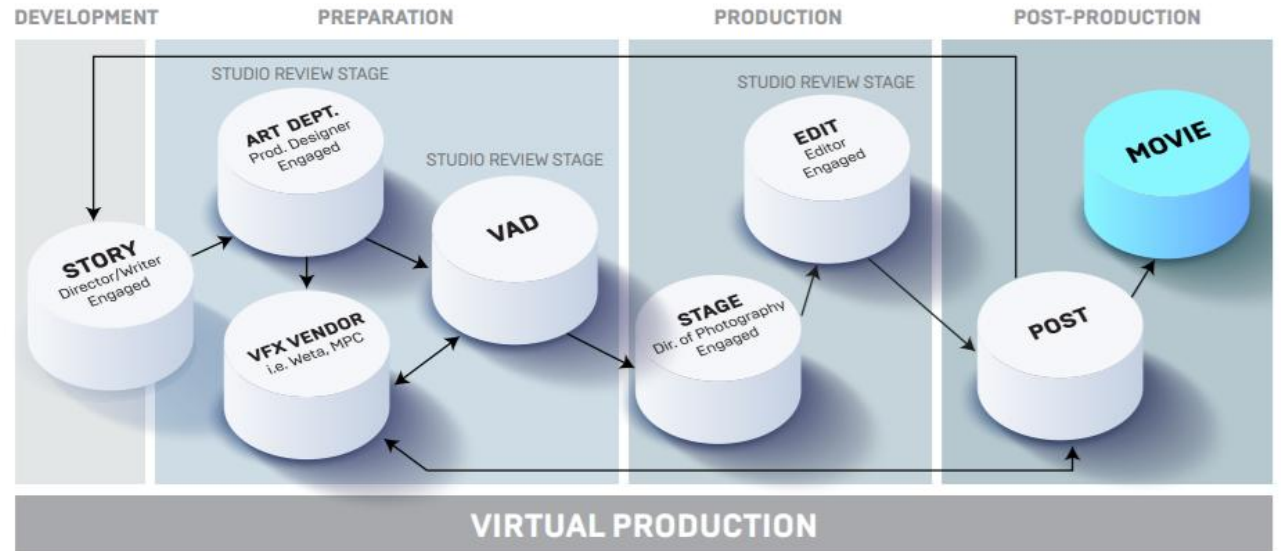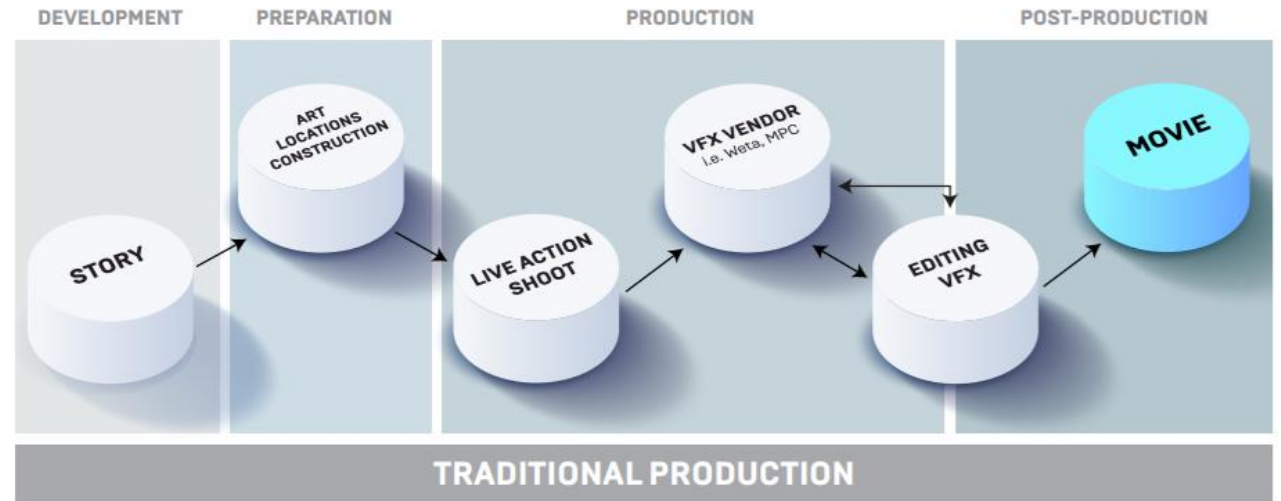
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Presenter: Zhiyuan Yu

Introduction

Virtual production combines virtual and augment reality with CGI and game-engine technologies to enable production crews to watch their scenes unfold as they are composed and captured on set.

Introduction

Unlike traditional CG films' linear production method, virtual production provides a "Real-Time" preview.

Film artists can make creative decisions on the set while scouting and filming in virtual scenes.

Aim and Objective:

Discover and analyze the development trend of Virtual Production in filmmaking in the past ten years, predicate the prospect of Virtual Production in the film industry.

Research Question:

1. What is the development trend of the application of VR technology in CG film production in the past decade?

2. What is the future prospect of the application of VR technology in CG film production?

Research Cases:

Avatar

2009

The Jungle Book

2015

Ready Player One

2018

Lion King

2019

Literature Review

Avatar, 2009

James Cameron had started to use primary VR concepts and techniques, applying motion capture technology to the cinematic camera, creating a virtual-camera system called "Simul Cam."

A virtual camera with the same track in the CG world was generated so that the live-action scene and CG scene were able to be composed in low quality, but director could preview the CG shot in real-time.

Literature Review

Avatar, 2009

It is undeniable that it laid a foundation for virtual-production in the film industry.

Avatar's VR technology is described as the "shoulder of giant" and plays the role of inspiration in many reviews below.

Literature Review

The Jungle Book, 2015

Most of the shots in the film are done in a closed virtual-studio. This new production model is called the **Warehouse model**.

A new department named "Digital Domain" was high-lighted in the Jungle Book.

Digital Domain is the primary virtual-production vendor on the film, in charge of everything from supporting the virtual art department.

Literature Review

The Jungle Book, 2015

The technical director of the digital domain introduced a unity video-game engine used in The Jungle Book, called Photon.

Photon was the first time a game engine was deeply applied to the feature film and previsualized the entire film from start to end.

Literature Review

The Jungle Book, 2015

Through the review, virtual production in The Jungle Book can be regarded as a revolutionary development.

The game engine began to participate in the rendering work, and the physical camera was gradually replaced by virtual-camera.

Literature Review

Ready Player One, 2018

Virtual artists in Ready Player One using Maya and other 3D modeling tools create virtual sets, props, vehicles, characters, and environments that could run in a modified version of real-time rendering game engine.

One of Jungle Book's changes was that filmmakers could scout the virtual sets in VR, which was considered an improvement after 2015.

Literature Review

Ready Player One, 2018

In Ready Player One's production, director could reach anywhere in OASIS with his virtual camera, like shooting films in the real world.

Compared with The Jungle Book, director owned more controls on the VR world created by the game engine.

It was more accessible and more flexible for filmmakers to scout and design the virtual scene by wearing VR Head-Mount Display.

Literature Review

Lion King, 2019

With the previous experience, Favreau brought virtual production element into Lion King.

To create lifelike CG scenes, the team shot footage of wildlife in Kenya, Africa, and used them as references for rendering CG shots.

Literature Review

Lion King, 2019

The virtual production team rendered an entire large CG landscape of Africa grassland, which helped relieve the physical limitations of filming, all the shots could be reshot at any time.

The boundaries between filmmaking and game-making had been blurred gradually.

Methodology

Longitudinal studies refer to collecting data at several different points in time to describe the development and change of phenomena and explain the connection between various phenomena.

This research selected **"trend studies"** as methodology.

Following the method of trend studies:

The **"secondary data"** about the VP of those four-film cases including videos, sounds, interviews, and texts were assembled and connected.

Data Collection

Quantity and Form of Data:

16 literal data (From XJTLU Library database & other website)

-Journal article (Hollywood Reporter, American Cinematographer......)

-Conference paper

-Web article

-Web news report

15 video data (From YouTube)

-"Behind the Scene" documentary

-Interview of director, cinematographer, producer, VFX supervisor......

- Live Talk about "Virtual filmmaking" (Unity, Unreal Engine)

-Recorded video of conference about "Virtual filmmaking" (SIGGRAPH)

Data Collection: Journal article & Web article

Journal article

Web article

Web article

Data Collection:

Documentary video

Avatar   2009
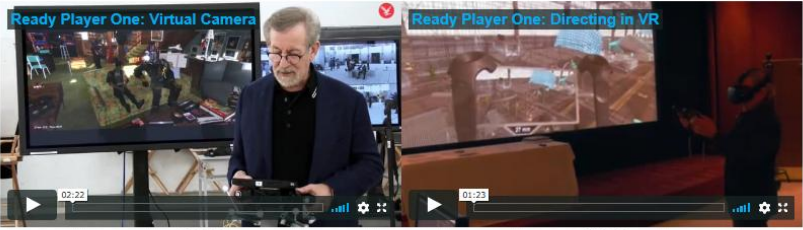
Ready Player One 2018

Data Collection:

Interview of filmmakers

Jon Favreau on Directing 'The Lion King' in VR and Working with Beyonce

2,543次观看 · 2019年7月30日

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Interview of Jon Favreau (Lion King)

30 Minuten mit Steven Spielberg & Ernest Cline - Über die 80er, digitale Welten & Ready Player One

Interview with Steven Spielberg (Ready Player One)

Data Collection:

Conference and live talk about Virtual Production

Unity's talk in SIGGRAPH 2018
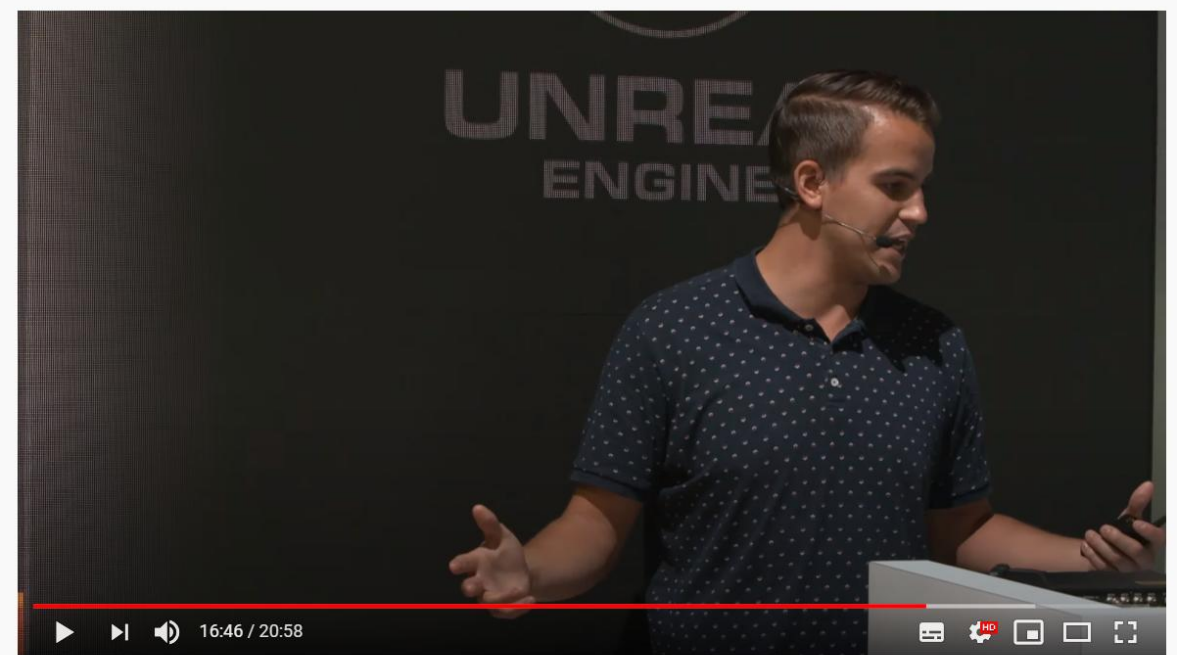
Unreal Engine's Talk in SIGGRAPH 2019

Database of the Research

Note of Video Data   Unique No. & Title   Timecode & key quote (important evidence)

No.1.2 AVATAR (2009) - Making Of and Behind The Scenes https://www.youtube.com/watch?v=_Y8Buy5b6DQ&t=22s

10:20 Rob Logano used virtual camera but in a post-production method, and he had the idea to apply the same thing to the performance capture. Jim and John visited a bale wolf set which is a blind cap which means reference camera only for the performance of actors and not seeing any rendered environment.

11:30 We put you in a special volume, the volume is the stage. Markers are on the actors' body and be picked up by hundreds of cameras on the top which provide different views.

12:00 When I hold the camera, I don't see the actors, I see the characters (already rendered), so I'm basically holding a monitor, no lens, just a marker on the set to see where the actors are moving   , It is called a camera, but it's not a camera.

13:32 First, I designed the concept illustration of Pandora's environment, which was inspired by the mountains of Guilin in China and the jungles of South America.

21:58 For VFX of character clothing, there is no reference in reality, so the real object should be made first, and then simulation should be converted into animation.

44:54 Virtual camera & reference camera (two different things) virtual camera shows what the shot will look like with the CG character and the world combined. Reference cameras are absolutely critical for getting exactly the moment that we want, and the animators take the referenced footage.

50:00 Build physical layout to help actor performance everything in the digital environment is modular, we can move or scale a big stone by only a few second.   Don't need to wait for the lighting and set different from traditional filmmaking.

53:00 Jim directs the actors how to perform with CG creature, because in the virtual world they are all there for him. Jim needs to view the virtual camera (monitor) to know about the virtual set.

56:00 Before making the CG scene, design the concept illustration first.

58:00 Jim could use the virtual camera (monitor) to scout the set and environment and adjust the set.

No.4.5 The Lion King and Virtual Filmmaking (with Caleb Deschanel) GCS179
https://www.youtube.com/watch?v=9sjhdU9FB7Q

06:52 MPC studio went to Africa and photograph grass, trees and rocks.

10:53 Lions are so closed to the cinematographer.

27:54 The technical team will attach the virtual dolly to the real a real dolly on stage (so that the shot will have a human feel, not just mechanical).

29:40 Stedicam operator needs to adapt the VR tools. In virtual reality the ground is tilt up or down but in stage is flat surface

35:30 Lens are designed with some aberration. Shot made by a perfect lens looks unreal. Most of the lens have anamorphic and distortion.

38:30 LIGHTING: We could virtually keep the sun in the same place all the time (if in live-action movie, the position of sun change and make the shots disconnected.

No.4.6 The Lion King 2019 - Making Of - How it was filmed in a realistic way
https://www.youtube.com/watch?v=KCnayCnM6Zk&pbjreload=10

06:12 Production Design Conceptual Art: illustrators render up an idea of a vision of the world at a high level of resolution, then going back to building blocks inside the computer, shaping, adding elements and dressing.

06:35 We are doing 100 miles radius circle of open vista landscape with grass, trees and rocks. Develop simulation to grow grass in different height, water erode certain surface.

08:14 Digital shots done by computer is perfect, but that perfection leads to a feeling that it's artificial, so we need to make it look likes it is really filmed.

09:02 We go inside the volume, a technology blank place, filled with grids that hold VR sensors : tell the computers where the virtual cameras, stedicam, dollies, cranes are in space. These are all feel like and look like real filmmaking equipment, except no camera attached. "We are giving the filmmakers all the analog tools that they are familiar with", their instincts are reliable, but the output is all through the real-time game engine.

10:26 VFX Supervisor Robert: the films we loved, there are some great shots looks like an accident, the computer eliminates that, nulls all "accident" out.

11:27 DoP Caleb: VR giving us the experience of being in the set.

15:30 Jon and his team (production designer, cinematographer) sitting in a small room, putting on VR headset and scouting the scene, discussing angle, composition of the shots (BEFORE animated character).

No.5.3 Fox VFX Lab - Virtual Production and Collaborative Filmmaking | SIGGRAPH 2019 | Unreal Engine
https://www.youtube.com/watch?v=ai6PH61PMvM

Virtual Production helps Collaborative Filmmaking

2:26 In the past, the VFX film production is linear, many decisions have to be made in post-production

5:10 Through VP, different artists could work together in the stage and create "Happy Accident"

5:48 Collaborate with actor Collaborate with cinematographer (Have More Creation Freedom, Inspire each other)

6:38   Save time and money

Change order: In traditional VFX film, VFX are set and done by team, it's hard to change, but in VP, director could find out the problem immediately in the set

More artists could work together, and things could be done at the same time (moving set, moving light)

10:25 Gamifying Film bring automatic and simplify for filmmakers, let them more comfortable to make film, put the control to the hands of the artists (They are not VP experts, and they don't need to be)

No.5.4 Real-Time engine for virtual production https://www.youtube.com/watch?v=U_NG7WfoI7s

4:38 Virtual camera in game   (the freedom to fly the camera anywhere and look at anything)

12:00 Location scouting (staffs from different departments could view the set and location visualize. (the great thing for this technology is we could bring Steve in and he could scout the set virtually.

13:19 It is difficult for director and actor to make film in a white room and white ceiling, it is hard to imagine the environment they are. So Steve ask the actors to also put on the VR helmet.

14:02 (little story) when Steve scout the location, he always has to put off the visor to drink, so they set markers on the drink and make it virtually.

24:24 comparison between Maya (keyframing camera) and Expozure (real-time virtual camera) in Tom Hank's new film.

26:00 Starting to demonstrate virtual photography, the line between game and film production is very blurred.

Database of the Research

Avatar

No.	Form	Title & Link	Content
1.1	article	https://doi.org/10.3969/j.issn.1002-6142.2010.03.002	Introduction and analysis of technology in Avatar
1.2	video	AVATAR (2009) - Making Of and Behind The Scenes https://www.youtube.com/watch?v=_Y8Buy5b6DQ&t=22s	"Behind the Scene" documentary of Avatar

Jungle book

| No.	Form	Title & Link	Content
2.1	article	Motion Capture and the Future of VR Computer Graphics World http://search.ebscohost.com/login.aspx?direct=true&db=edsgea&AN=edsgcl.526809777&site=eds-live&scope=site	Motion capture and virtual production in Jungle Book
2.2	article	Welcome to the Jungle. (cover story) http://search.ebscohost.com/login.aspx?direct=true&db=f3h&AN=115370431&site=eds-live&scope=site	Behind the scene of Jungle Book
2.3	video	JUNGLE BOOK reveal BBC https://www.youtube.com/watch?v=yBpRQU6avHM	Interview of VFX supervisor from MPC in Jungle Book
2.4	video	The Jungle Book (2016)	Production B-Roll https://www.youtube.com/watch?v=69PWu5DIwI4	Production b-roll of Jungle Book
2.5	video	Go Behind the Scenes of The Jungle Book (2016) https://www.youtube.com/watch?v=zTebgHNSe_4	"Behind the Scene" documentary of Jungle Book

Read Player One

No.	Form	Title & Link	Content
3.1	article	VIRTUaL INSaNITY. (cover story) http://search.ebscohost.com/login.aspx?direct=true&db=f3h&AN=128637787&site=eds-live&scope=site	Virtual production in Ready Player One
3.2	article	Virtual Reality: Ready Set Go. http://search.ebscohost.com/login.aspx?direct=true&db=bsu&AN=130345595&site=eds-live&scope=site	Virtual production in Ready Player One
3.3	article	How 'Ready Player One' Combined Virtual Production And Motion Capture Tools To Create Digital Characters https://www.cartoonbrew.com/vfx/how-ready-player-one-combined-virtual-production-and-motion-capture-tools-to-create-digital-characters-157821.html	Virtual production and motion capture in Ready Player One
3.4	article	Ready Player One' Juxtaposes Real, Virtual Via VFX From Three Shops https://variety.com/2019/artisans/production/spielberg-ready-player-one-vfx-1203144265/	Virtual VFX in Ready Player One
3.5	video	STEVEN SPIELBERG'S READY PLAYER ONE https://girishbalakrishnan.com/redesign/portfolio-posts/ready-player-one/	"Behind the Scene" documentary video of Ready Player One
3.6	article	Cinematographer Janusz Kaminski Warns That Directors of Photography Are Losing Control of Images They Shoot https://www.hollywoodreporter.com/behind-screen/cinematographer-janusz-kaminski-warns-directors-photography-are-losing-control-images-they-shoot-1101082	DoP's opinion in Ready Player One
3.7	video	VRLA 2018 – From Today's VR To Ready Player One - A Roadmap https://www.youtube.com/watch?v=MCPSZOKUV1Q	VRLA 2018 Conference Recording Video
3.8	video	30 minutes with Steven Spielberg & Ernest Cline - About the 80s, digital worlds & Ready Player One https://www.youtube.com/watch?v=0ykZkJ2Ua9o	Interview of Steven Spielberg about the production of Ready Player One
3.9	video	Steven Spielberg: From Pong to Ready Player One https://www.youtube.com/watch?v=ChYrf85pvXs	Interview of Steven Spielberg about the production of Ready Player One

Lion King

No.	Form	Title & Link	Content
4.1	article	Jon Favreau. Hollywood Reporter http://search.ebscohost.com/login.aspx?direct=true&db=bsu&AN=138218269&site=eds-live&scope=site	Introduction of Jon Favreau and Lion King
4.2	article	Hollywood's New King: 'Virtual Production. http://search.ebscohost.com/login.aspx?direct=true&db=bsu&AN=137583463&site=eds-live&scope=site	Virtual production in Lion King
4.3	article	To Be King. American Cinematographer, http://search.ebscohost.com/login.aspx?direct=true&db=f3h&AN=137653348&site=eds-live&scope=site	Virtual production and cinematography in Lion King
4.4	article	RETURN OF THE KING. (cover story). http://search.ebscohost.com/login.aspx?direct=true&db=f3h&AN=136084958&site=eds-live&scope=site	Behind the scene of Lion King
4.5	video	The Lion King 2019 - Making Of - How it was filmed in a realistic way https://www.youtube.com/watch?v=KCnayCnM6Zk&pbjreload=10	"Behind the Scene" documentary video of Lion King
4.6	video	The Lion King and Virtual Filmmaking (with Caleb Deschanel) GCS179 https://www.youtube.com/watch?v=9sjhdU9FB7Q	Radio interview of the director of photography of Lion King
4.7	article	THE LION KING' AND 'THE MANDALORIAN'S' JON FAVREAU IS ALL-IN ON VIRTUAL PRODUCTION, REAL-TIME AND LEDWALLS https://beforesandafters.com/2019/07/30/the-lion-king-and-the-mandalorians-jon-favreau-is-all-in-on-virtual-production-real-time-and-led-walls/	Report of Jon Favreau's talk on Siggraph 2019
4.8	video	Jon Favreau On The Lion King, The Mandalorian And Virtual Production - BBC Click https://www.youtube.com/watch?v=0aiAP_zjub	Interview of Jon Favreau about virtual production
4.9	video	Jon Favreau on Directing 'The Lion King' in VR and Working with Beyonce https://www.youtube.com/watch?v=nBWg8PqBJPg	Interview of Jon Favreau about the production of Ready Player One
4.10	article	The Lion King: a film shot inside a game engine, with VR and Virtual Production https://www.provideocoalition.com/the-lion-king-a-film-shot-inside-a-game-engine-with-vr-and-virtual-productioon	Game engine and virtual production in Lion King

Virtual Filmmaking

| No.	Form	Title & Link	Content
5.1	article	THE VIRTUAL PRODUCTION FIELD GUIDE https://cdn2-unrealengine-1251447533.file.myqcloud.com/Unreal%20Engine%2Fvpfieldguide%2FVP-Field-Guide-V17_Digital-2761132530189516 9b008441b09fe595ecf31f32.pdf	Field guide of virtual production (by Unreal Engine)
5.2	article	Introduction of virtual cinematography (by unity) https://unity.com/madewith/virtual-cinematography	Introduction of virtual cinematography (by unity)
5.3	video	Real-Time engine for virtual production https://www.youtube.com/watch?v=U_NG7WfoI7s	Unity's live talk of virtual production in Siggraph 2018
5.4	video	Fox VFX Lab - Virtual Production and Collaborative Filmmaking	SIGGRAPH 2019	Unreal Engine https://www.youtube.com/watch?v=ai6PH61PMvM	Unreal Engine's live talk of virtual production in Siggraph 2019
5.5	video	Unreal Engine User Group at SIGGRAPH 2019 https://www.youtube.com/watch?v=apLzZBqfqeU	Unreal Engine User Group conference at Siggraph 2019 recording video

INITIAL RESULT & ANALYSIS
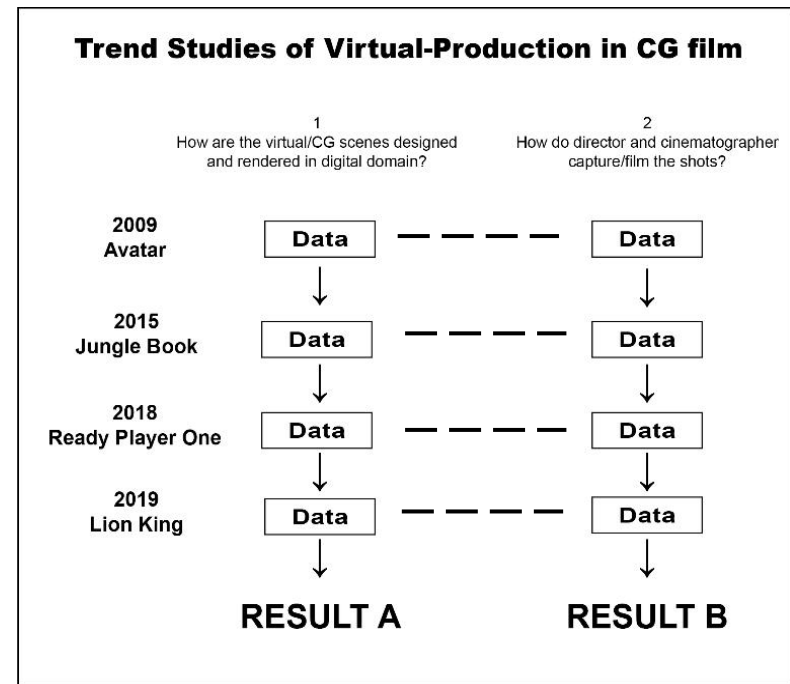
INITIAL RESULT & ANALYSIS

Avatar

2009

The Jungle Book

2015

Ready Player One

2018
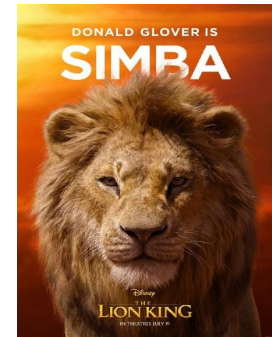
Lion King

2019

STAGE 1

STAGE 2

STAGE 3

INITIAL RESULT & ANALYSIS


Avatar

2009

The Jungle Book

2015

STAGE 1

- Application of Simul Cam (virtual camera system)

- Achieve real-time preview of VFX shots in low quality

- Initial interaction between actor and CG elements (In 2D monitor)

- Using traditional animation software (Maya) to create CG elements

- **DIRECTOR** participate in the virtual production

-BUT **PRODUCTION DESIGNER, CINEMATOGRAPHER** **did not** participate in the

virtual production

INITIAL RESULT & ANALYSIS

Ready Player One

2018
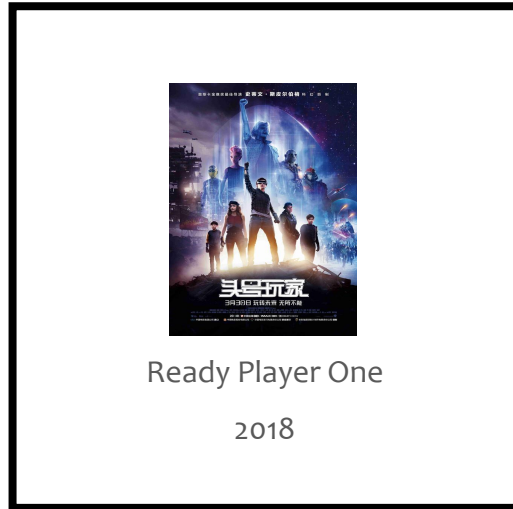
STAGE 2

- **Game Engine** support the render of the virtual scene, set and character

- Application of VR headset (VIVE)

- Immersive VR production design and scouting of the film scene

- **PRODUCTION DESIGNER** participate in the virtual production

- Virtual cinematography (Camera inside the VR environment)

-BUT **CINEMATOGRAPHER** did not participate in the virtual production

Lion King

2019

STAGE 3

- Construct the entire film scene and CG animals in **Game Engine**

- Immersive VR production design and scouting of the film scene

- Combination of virtual production and **classic film crew**

- Use **classic cinematography equipment** to film in **virtual environment**

- **LIVE –ACTION CINEMATOGRAPHER** participated in the virtual production

- Create **familiar cinematographic experience** and **"Happy Accident"** (make it seems like a live-action film)
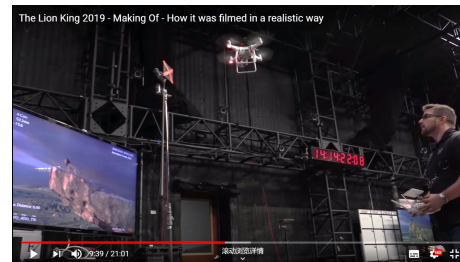
INITIAL RESULT & ANALYSIS

Avatar	The Jungle Book	Ready Player One	Lion King
2009	2015	2018	2019

A TREND / PROCESS THAT:

The digital mode and tools of **CG scene and character creation** transformed from **traditional animation software** to **game engine**.

The **participation** and **collaboration** of **various filmmaking roles** in Virtual-Production increased gradually.

The **combination** of **Virtual-Filmmaking** and **classic filmmaking culture** enhanced gradually.

INITIAL RESULT & ANALYSIS

The **participation** and **collaboration** of **various filmmaking roles** in Virtual-Production increased gradually.

STAGE 1	STAGE 2	STAGE 3

Avatar

2009

Director

The Jungle Book

2015

Ready Player One

2018

Director

Production Designer
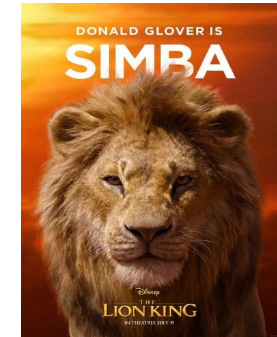
Lion King

2019

Director

Production Designer

Cinematographer

<u>FUTURE PROSPECT OF VIRTUAL FILMMAKING</u>

- Real-Time LED Screen

- Interaction of **<u>actor</u>** and virtual environment

- Enhance the **<u>immersion experience</u>** of actor
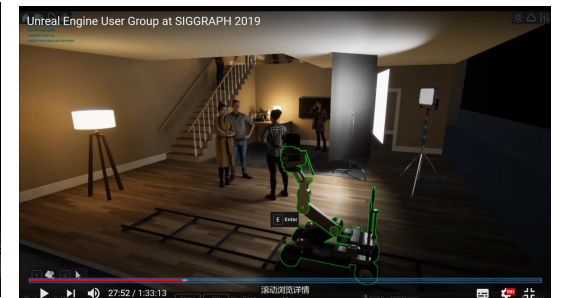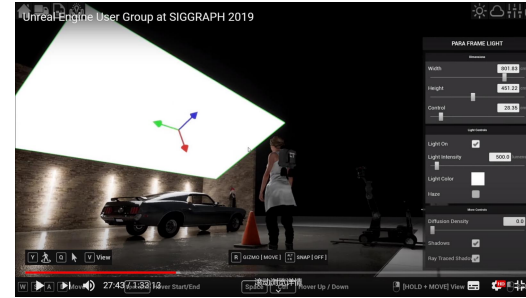

Epic Games – Unreal Engine

Real-time LED Virtual Production Demo

INITIAL RESULT & ANALYSIS

FUTURE PROSPECT OF VIRTUAL FILMMAKING

Real-Time VFX

Cine Tracer

(cinematography & lighting simulator)

THANK YOU