IRIDiuM+: Deep Media Storytelling with Non-linear Light Field Video

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ABSTRACT

We present immersive storytelling in VR enhanced with non-linear sequenced sound, touch and light. Our *Deep Media* (Rose 2012) aim is to allow for guests to physically enter rendered movies with novel non-linear storytelling capability. With the ability to change the outcome of the story through touch and physical movement, we enable the agency of guests to make choices with consequences in immersive movies. We extend, IRIDiuM (Koniaris et al. 2016, 2017) to allow branching streams of full-motion light field video depending on user actions in real time. The interactive narrative guides guests through the immersive story with lighting and spatial audio design and integrates both walkable and air haptic actuators.

CCS CONCEPTS

• **Computing methodologies → Image manip.**; *Virtual reality*;

KEYWORDS

real-time rendering, VR, light fields, non-linear storytelling

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1 DEEP MEDIA

Deep Media (Rose 2012) focuses on enabling guests to immerse in stories to any level they choose. Our practical definition here, enables degrees of freedom for as many senses as can be effected by the system implementation. In our IRIDiuM+ system, we include non-linear sequenced physical, audio and visual displays (Fig. 1).

1.1 IRIDiuM+

Underpinning this work, we extend the IRIDiuM (Koniaris et al. 2016, 2017) animated light field method, which go beyond regular 360° fixed point of view video. Fixed 360° video lacks immersion since the guest's head translation is not considered and visually induced motion sickness (VIMS) can arise from a mismatch of visual-vestibular stimulus (Hettinger and Riccio 1992).

The key advantage of IRIDiuM is the ability to take movie content made for high quality non-real time production renderers such as RenderMan, and process into a full motion light field video format

Figure 1: Immersive light fields with non-linear storytelling.

for real-time playback with freedom of movement (Fig. 2). This allows us to preserve the high quality imagery associated with costly film production content and deploy it into video games and Virtual Reality real-time settings without extensive reworking and tuning of 3D assets (meshes, materials, effects, etc.), or compromising on the quality of imagery. To achieve non-linear storytelling with interactivity for full motion light fields, the custom video format is held on a 'decision point' frame (or frames of idle cyclic sequence), and once the branch of the storyline is determined through the guest's actions, then the further frames of a selected unique sequence are paged into video memory (VRAM) for efficient real-time decoding.

2 GUIDED STORYTELLING WITH LIGHT, TOUCH AND SOUND

In traditional film, narration story is revealed in a directed manner from a controlled/specific viewpoint through combination of *mise en scène* and montage techniques like hard cuts, camera movements (zoom, pan, tilt, etc) and time manipulation (time compression/expansion). In VR, preserving immersion is essential, and requires continuity of time and space for a comfortable experience.

In our sample experience, we deploy traditional film *mise en scène* technique combined with *Guided Storytelling* to preserve story continuum, where VR users have the freedom to view the story from any point in space and choose their path in the narrative.

Guided Storytelling relys on attracting the user to look into a 'story hot' location, yielding more comfortable story consumption, while preserving the freedom of movement. We achieve this by using *visual*, *sound*, and *emotional* drivers to encourage the user move in space, or to look in a *desired* direction: ***Visual*** Motion/on screen action (animation and change) Contrast (light and colour); ***Sound*** Spatial sound according to the guest's pose in space; ***Emotional*** Exploration and curiosity (door opens and new space is explorable).

2.1 Enriching Agency

Here, we define agency as the ability for an actor (the guest) to act in the given audio/visual and physical virtual environment. For enriched agency, we further integrate synchronised haptic and sound devices with the intent to add greater *viscerality* of feedback to the agent. This embeds the guest in the story more physically than simply through visual stimulus, removing some of the gaps

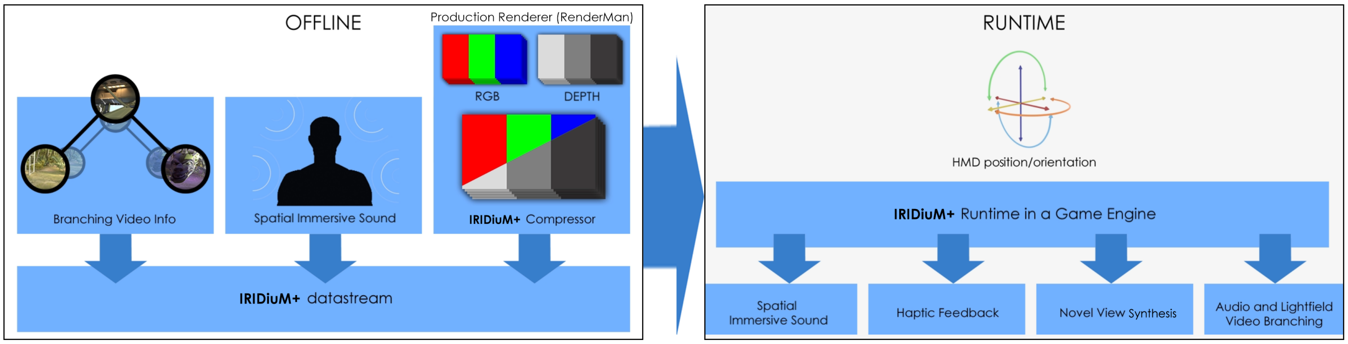

Figure 2: Offline to real-time IRIDiuM+ production pipeline.

between the synthetic reality and those sensed in regular reality. And so, increasing the feeling of being 'in the story'.

2.2 Haptic Media

Interactive storytelling gives the user freedom of choosing the way they consume the narration. This might weaken the narrative leading to a lack of empathy with the characters, and a lack of engagement with the events of the story (Clarke and Mitchell 2001). Haptics is a powerful device that we use to combat this (Fig. 3).

2.2.1 Walkable Haptics. Haptic floor coverings of materials mimicking those in the rendered environment (soft rug and artificial grass) are registered and calibrated to HMD lighthouse tracking system's coordinate space. Under these (formed in a shallow mound to avoid trip hazard), there is a transducer to effect vibrations as the story's media sequence unfolds. These provide both passive (material) and active (vibration) responses for our walkable haptics.

2.2.2 Air Haptics. Blowers provide breeze and hot air according to the story outcomes (door opening, bunker vs outdoor environment, creature's breath). The spatial arrangement of the blowers is design to provide low airflow within the bunker away from the emitter sources and higher airflow as the guest exits *virtually*.

Figure 3: Air haptics with active/passive walkable haptics.

2.3 Storytelling with IRIDiuM+ Branching

We present a nonlinear story experience with two alternate narratives (Table 1). Our primary mechanism for story branching employs user action as input. We track user location and trigger the relevant story branch. Staying in the 'safe zone' vs 'leaving the safe zone' resolves in happy vs horror *development* of the story.

The narrative sequence begins inside a scientist's laboratory bunker in the depths of a tropical swamp investigating strange sensor readings. Light from the outside is designed to guide the guest towards this direction (Calahan 1996) and this poses the question whether to move towards the door and outside? ***Horror Sequence*** The scientist (guest) begins standing on a soft rug. If the guest moves off the rug too quickly making a noise on the metal floors with footsteps, the swamp creature is startled and makes an angry response. In turn, this alternate path for light field movie data is paged in along with the haptics metadata. ***Happy Sequence*** After a time, if the guest has not moved from the rug, the happy swamp creature path is chosen, with an alternate deep media sequence. In reward, the guest can walk out side and interact with the creature.

2.4 Deep Audio in Virtual Reality

Finally, we use spatial sound in support of virtual storytelling. Head tracking 6DoF pose data allows spatial rendering of Foley and environmental sounds to enhance the sense of realism of virtual objects and immersion in virtual environment (Murphy and Pitt 2001). Audio is integrated in IRIDiuM as localized sound effects and ambience in space (3D) and time (video frame and story branch).

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Table 1: Synchronised Branching Deep Media Timeline.

Path	Modality		Synchronised Timeline	
			Decision Cycle	Outcome
Happy	Haptic	Walkable	Rug	Rug Vibration
		Air		Gentle Breeze
	Audio		Lab Sound	Outdoor Life
	Visual		Neutral	Bright
Horror	Haptic	Walkable	Rug	
		Air		Hot Blast
	Audio		Lab Sound	Angry
	Visual		Neutral	Dark