

VR Kino+Theatre: from the ancient greeks into the future of media

Luiz Velho, Leonardo Carvalho and Djalma Lucio

IMPA - VISGRAF Laboratory

Abstract

VR Kino+Theatre is a media platform that combines theatrical performance with live cinema using virtual reality technology.

CCS Concepts

•**Computing methodologies** → *Graphics systems and interfaces*; •**Applied computing** → *Media arts*;

1. Introduction

In the past recent years, technology advances in Computer Graphics approached a rupture point that announces significant changes in the field as a whole. In particular, Modeling, Animation and Rendering are reaching new levels.

As a consequence, these changes open up a wide range of possibilities that are being incorporated into many new media modalities. Some examples are: 360 degree videos, Live Cinema, Immersive Location Experiences and VR Theatre.

The main challenge to shape the emerging medium is the development of a new language, supported by suitable creative tools, making possible content production. In that respect, initiatives from organizations like the Oculus Studio, Google Spotlight Stories and the ILMxLab, are already exploring this uncharted terrain.

Nonetheless, the quest for the next form of audio-visual communication and entertainment is still in the very beginning — no definitive answer is in sight yet. The problem is complicated by the fact that a solution needs to balance financial, cultural and other aspects in order to be viable for the industry. A strong testimony of this dilemma is the MIT Technology Review article, by Ty Burr, entitled “Hollywood Has No Idea What to Do with VR”.

2. The VR Kino+Theatre Platform

VR Kino+Theatre is our contribution to a long term solution for the above mentioned problem. The platform integrates traditional forms of entertainment (theatre and cinema), with advanced interactive media, (virtual reality and gaming). In this way, it solves at the same time scalability of audience and presentation familiarity, while providing greater flexibility for innovative alternative formats. Think, for example, the possibilities for a Broadway show.

The foundations of our proposed solution lies onto three pillars

related to technological, production, and delivery aspects which, we believe are the directions for the future.

On the technology front: i) exclusively 3D content captured from real data with the help of advanced sensors and machine learning; ii) procedural and real-time physical simulations powered by high-end graphics hardware; iii) distributed systems interconnected by low-latency wireless networks.

On the production side: i) completely unified process, in terms of both ubiquitous data access and augmented content generation; ii) collaborative real-time integrated authoring shared by all members of creative teams.

On the delivery scenarium: i) diversified media and application options; ii) multiplicity of presentation formats; iii) stratified and complementary fruition allowing to fully explore the content in many forms.

The operation of an ecosystem based on these principles entails new roles for producers, performers and participants. The content producers: director, art designers, cinematographer, composer and other technical people benefit from a powerful creative environment. The performers: actors, musicians, director expand their expression capabilities with VR interactive tools. The participants: general public and aficionados have a wide range of possibilities to experience content at various levels and in different modalities, from passive to immersive and interactive.

3. System Architecture

The architecture of VR Kino+Theatre is designed to be compliant with requirements described in the previous section.

3.1. Logical Components

The logical components of the system are: the *Kino+Theatre Engine*; the *Action Manager*; and the *Sound Manager*.

The Kino+Theatre Engine is embedded in all programs of the platform, and it is composed of: a *KT Communication Layer* – responsible for connection with the Action / Sound Managers; and a *KT Core* – that implements content-related functionality. The Action Manager deals with the seamless global distribution of motion and events within the network. The Sound Manager controls the low-latency audio capture / transmission.

In our current implementation, the Kino+Theatre Engine is based on Unity, while the Action and Sound Managers rely, respectively, on Holojam and Mumble.

3.2. Physical Environment

The physical environment of the system can be divided in two components: Network and AV (Audio-Visual) hardware/software. The Network environment supports real-time data streaming and interconnectivity within a server-client structure. The AV environment delivers content presentation and interactivity – it includes VR Stages and other spaces with associated equipment.

3.3. Data

The content in the system is composed of dynamic and static data.

Dynamic data includes: *Motion*, from actors and objects; *Audio* from actors and musicians; *Events*, triggers of cameras / effects.

Static data includes: *3D Models*, i.e., sets and props; *Avatars*, characters; *Virtual Cameras / Lights*; *Effects / Animation Procedures*;

3.4. Timeline

The system operates in real-time and, as a consequence, it is time-dependent. In that respect, the concept of a *Timeline* is essential.

A VR Kino+Theatre experience, in general, has a script and narrative that are associated with a timeline.

The experience is constructed, rehearsed, and presented. During these phases, the dynamic data of a session can be recorded to be edited and played – in a *kino+theatre session* (.ks) file.

The session data structure has a timeline that includes the following elements: *Motion / Events Stream*; *Audio Stream*; *3D Graphics Simulation Processes*. Besides these data elements, the structure also contains *Metadata*, such as Tags and Markers. Additionally, it may be stratified into *Layers*. This is useful to separate motion and audio from individual characters, for example.

4. Software

The functionality of VR Kino+Theatre is implemented as a suite of programs that contemplate the various aspects of the system operation. Below we list the categories of software and describe the main programs in each category.

- Servers – programs that manage data within the network: *Holojam*, for motion streaming; *Mumble*, for audio streaming.
- Sensing – programs that acquire data: *Optitrack Motive*, for Motion Capture.

- Active – programs that generate stream data: *Actor*, sends / receives motion and audio of the corresponding performer; *Director*, sends camera trigger events and other controls; *Audience Participant*, receives / sends motion of individuals from the public.
- Passive – programs that consume stream data: *Projector*, receives all stream data (motion, audio, triggers) to render the Cinema presentation in real-time; *Audience Viewer*, receives stream data to render a VR presentation.
- Content – programs that manipulate the Timeline data: *Recorder*, creates the *ks* file from the data streams; *Player*, decodes and streams the *ks* file to the network.
- Production – programs that allow content generation: *Editor*, makes modifications to a *ks* file; *Blocking Planner*, facilitates the definition of the actors movements in the stage; *Set / Stage Modeler*, help the construction and lay-out of the elements of a scene.

5. Spaces

The VR Kino+Theatre platform is all-encompassing in the sense that it allows a multiplicity of complementary presentation formats. As such, experiences can be delivered in various configurations of multiple spaces. For example, the actors perform on a VR stage, while the director selects in real-time the views that are shown on the live movie projection screen.

5.1. Functional Areas

An experience requires three types of areas:

1. VR Stages - for performance and interaction. It is used by the actors and active experience participants.
2. Control Areas - for operation of elements and parameters. It is used by the director to switch the cameras and staff members for general functions, such as sound / light changes.
3. Presentation Spaces - for content delivery. It consists of the movie theatre and other viewing spaces for the audience.

5.2. VR and Presentation Spaces

The VR Kino+Theatre platform makes use of immersive VR, as well as, regular 2D / 3D screen projections, each in its own space.

Regarding the VR technology, the platform features a modality that we call “Situating Participatory Virtual Reality” which combines full body tracking in tangible spaces with real / virtual objects. This makes possible to create shared virtual environments that can be either co-located (where users are in the same physical space) or remote (where users are in separate spaces).

6. The Tempest

As a demonstration of the platform capabilities we produced an experience based on the play “The Tempest”, by William Shakespeare. The project was developed by a multidisciplinary group of theatre and media technology professionals. It has been shown in two public presentations at IMPA in Rio de Janeiro.

The experience was very successful, with positive feedback from all participants, including actors and the general public.