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**Art in Real-Time: Theatre and Virtual Reality**

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[Version en français](#)

**Abstract:**

The art of the theatre has many similarities to the phenomenon of virtual reality. A theatre performance and a VR experience both are time based, existing only during that time that the human participants are engaged with them. Both rely on the creation of a fictive universe designed to entertain, inform, and enlighten.

At the University of Kansas a program of experiments spanning the past 8 years have explored virtual reality technologies as they can be applied to theatre production. Initially, a wide variety of VR systems were tested as tools for the traditional scenographer and number of productions were designed using these techniques. Later, a series of theatre pieces were produced using virtual reality as the scenographic medium. Real-time simulations coupled with live actors to form a new form of stagecraft.

The aim VR/Theatre productions such as The Adding Machine, Wings, Tesla Electric and

Machinal was to interface VR systems, live actors, and theatre audiences in such a way as to reveal the emotional context of these plays using dynamic, and ephemeral virtual scenery. Every production met this goal with alternating successes and disappointments, but always furthered the better understanding of both theatre and VR.

The development of virtual reality based scenography at the University of Kansas followed a natural progression as techniques were learned and technologies came available. Each experiment and its resulting theatrical production displayed new technologies and applications and became the building block for those experiments that would follow. During the course of our many experiments and productions, those involved with the work formed the Institute for the Exploration of Virtual Realities or i.e.VR

Beginning in 1987, simple tests were conducted to determine how computers could be used as tools in the planning of traditional stage productions. Computers were used to create technical drawings for scenery, lighting and stage properties. Following that, the tests were expanded to include less mathematically precise, more artistically conceived graphics such as costume renderings, scenic sketches and lighting storyboards.

After it was concluded that computer-generated images (CGI) graphics could, when properly prepared, serve a production as well as traditional design media, the next step was to create 3 dimensional scenic models on the computer. As this new technique was being explored, new software tools became commercially available that would allow the user to change the viewpoint into on the computer model in real-time, thereby giving the illusion of "walking-through" the model. This ability to access a computer modeled environment in real-time is the first defining characteristic of virtual reality. These walkthroughs proved to be very valuable visualization tools for scenographers.

The next step in the process was to devise methods to render life-size walkthroughs in order to better represent how the proposed scenery would appear onstage. In 1992 several methods were tried including head-mounted displays and life size projections onto rear-projection screens. Rendering the image of the virtual environment in actual size on a screen the width of the stage, or creating the illusion of such a large image through the head-mounted display creates the sense of immersion in the virtual environment. This sense of immersion is the second defining characteristic of what is generally considered to be virtual reality (VR). Although it was determined that the life-size projections were too cumbersome to be of practical use to a working designer, they did provide the germ of an idea that we would spend the remainder of the decade developing. If virtual scenery could be projected life-size on the stage, couldn't those projections serve as the scenic medium for future productions?

The first production to test the idea of virtual reality scenery was the 1994 staging of Elmer Rice's *The Adding Machine*. This production of *THE ADDING MACHINE* attempted to demonstrate ways in which virtual reality technology can be used to illuminate an existing dramatic text. Used not merely as spectacle for its own sake, but as a new scenographic medium in the service of the script, virtual reality becomes another component of the collaborative theatre art.

One of the first scenes to ever be staged with VR technology remains one of the best examples of its potential; scene 2, in which Zero is fired by his boss. At the beginning of this scene, the characters of Zero and Daisy are working at the office, Daisy reading numbers while Zero adds them. Behind them is a representation of the office and what appears to be the actors' shadows on the screen. As Zero and Daisy grow weary of the monotonous task and begin to daydream, the actors leave their positions and move about the stage while speaking their dream monologues. However, the shadows remain in their original positions. This effect was used to visually

demonstrate that the characters have not actually left their work and the movement of the actors is only psychological. At the same time the virtual office is moved into the far background as another sigh that the character's minds have traveled far from their jobs. Later in the scene Zero interacts with his Boss, portrayed by an actor who performs off-stage in front of a video camera. The video image of the boss was then superimposed into the computer generated office. By zooming the camera, the boss was made to "grow" during the scene appearing larger as he becomes more of a threat to Zero. In the end, the Boss fires Zero and his laughing face fills the entire screen.

### Image 1

The second experimental VR production was Arther Kopit's Wings. The goal of this experiment was to advance the technology and techniques discovered during production of The Adding Machine but enhance the sense of immersion for the audience. We utilized the projected computer graphic system developed for The Adding Machine, but further required that each audience member wear a unique head-mounted display (HMD). The HMD we chose to use was i-glasses! by Virtual i-O. Using i-glasses!, audiences were still able to see live actors on-stage and computer graphics projected onto rear projection screens. However, they were also presented with computer graphics and live video images projected within the HMD.

The use of HMDs by an audience in a fully mounted production was another first for the VR On-Stage Project. The "see through" technology of i-glasses! made it possible for the user to see through the built-in video screens. Using these unique HMDs, the audience still maintained a strong connection with the live actors. and the communal nature of the theatre experience was not lessened.

i-glasses! allowed us to present virtual-worlds, computer generated objects and video images directly before the eyes of an audience. Symbolic devices, realistic locals, expressionist images, or

even close-ups of the actors were superimposed over the view of the actors.. By equipping the audience with i-glasses! we sought to devise a powerful method of communicating the main character's chaotic state of mind as she suffers a stroke and fights for recovery. While looking through Emily's mind's eye, the audience shared her perceptions of the world around her, the confused sights and sounds of the hospital, her memories, and her attempts to communicate with other characters.

### [Image 2](#)

### [Image 3](#)

The third major VR/Theatre production was a departure from our previous commitment to real-time CGI. In Tesla Electric we experimented with a new technique of immersing an audience into a virtual environment. In our first two productions, we used real-time graphics to give our audience an illusion of moving along with the on-stage characters. In order to optimize the real-time animation of the virtual worlds, the detail and complexity of the scenes needed to be limited. For Tesla Electric we reversed the principle and created computer generated scenes that were not navigated in real-time but were lavishly detailed and textured. Instead of being presented through the use of a computer, the scenic images were rendered in very high resolution and printed onto 35mm slides. In order to add life to the static scenes we experimented with superimposing animated objects into the images.

In order to maximize the illusion of immersion, live actors played in front of a very wide panoramic triple screen on which the scenery was rear-projected. Again we employed stereo imaging so that the audience saw the scenes in 3-Dimensions with the aid of special 3-D "sunglasses". Three screen and stereoscopic imaging meant that for each scene, we need to create six images. To achieve the highest quality of computer graphics possible, much of the rendering was done with Radiance. Radiance is an application that renders

something like more common ray-tracing programs but much more accurately.

[Image 4](#)

[Image 5](#)

[Image 6](#)

During the production, it seemed clear that the static images used in Tesla Electric did not have the same potential for expression that real-time graphics did. Our 1999 production of Sophie Treadwell's *Machinal* drew upon, and further refined the techniques we discovered in past i.e. VR productions, particularly *The Adding Machine*.

*Machinal*'s main scenic elements consisted of virtual environments projected in stereoscopic 3D onto rear-projection screens. As an improvement of previous productions, *Machinal* employed new Digital Light Processing projectors, powerful computer workstations and state-of-the-art VR software. We also incorporated a variety of live and recorded video images.

[Image 7](#)

The overall concept of the piece was that the lead character, Helen, is run over and ground up by the inhuman, unfeeling, and mechanized society of early 20th century America. To give visual and tangible form to this idea, we created each virtual scene around some great and inexorable machine.

In the kitchen (episode 2) Helen must decide if she is going to accept the marriage proposal made by her boss in the first scene. She and her mother discuss it in their tiny tenement kitchen. She does not love her boss and is even repulsed by him, but finally decides to marry him in an act of seeming desperation. Behind the kitchen walls, and seen through the window, we placed an enormous clock, ticking away relentlessly. This was done to add an air of urgency to the scene and to underscore the idea that Helen is getting older

and risks becoming like her bitter mother. Her life is wasting away in this grubby lifestyle. The clock helps establish the motive for her desperate decision.

### Image 8

The trial (episode 8) was one of the most powerfully expressionistic scenes in the play. Helen sits alone on a chair precariously balanced over great, revolving rows of tearing spikes; similar to those found in wood shredding machines. Behind her, a giant arm holds the scales of justice, slowly tipping up and down. The faces of the defense and prosecuting attorneys appear on screens suspended over the stage on stage right and stage left. The face of the judge is superimposed over the scene on the main screen.

While this does not resemble any actual court room, it was designed to reveal Helen's emotional reaction to her predicament. This is the nature of expressionism, creating visual depictions of emotion. A number of audience members later commented on how uneasy they felt during this scene.

Using computers for these effects we are able to move freely through the virtual settings in an almost cinematic fashion. It allows us to change from one fantastic location to another in an instant. We can also alter these simulations a great deal in a very short amount of time. For instance, the final scene was changed after nearly every dress rehearsal until we felt we had it right. Thereby the scenery is very fluid, not only in the dynamic way it is presented to the audience, but in the way it is created and is altered to better fit with the actions of the live actors.

Currently, I am working on Fellowship at the University of Kent at Canterbury, England. As director of i.e.VR we have formed an alliance with the Kent Interactive Digital Design Studio, a group developing the use of computers in theatrical visualization, with both historical and practical ends. The project at hand is a new VR/Theatre production of Shakespeare's A Midsummer

Night's Dream. This planning for the production is only started, but it seems clear that it will include many of the hallmarks of previous productions: real-time virtual scenery, stereoscopic immersion and live performers.

For more information on this and all of our past work, look to the websites:

<http://www.ku.edu/~ievr/>

<http://www.ukc.ac.uk/sdfva/KIDDS/index.html>

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