

## **Virtual Reality in Theatre Production: Interactive Tools of Expressionism.**

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### **Abstract**

At the University of Kansas, A series of experimental theatre productions have been produced over the past 6 years. During those productions, virtual reality technology has been found to be very effective as a scenic device, particularly when used in the artistic style of expressionism. This essay cites *The Adding Machine* and *Wings* as two theatre productions that used virtual reality within the framework of theatrical expressionism. It then discusses *Tesla Electric* as an example of realism and compares the use of virtual reality scenery within the two styles.

### **1 Introduction**

Scenographers have long sought to create performance environments that not only define the suitable time and place in which to stage productions, but instead create spaces that help convey the metaphysical themes of the plays in production. A key obstacle in achieving this goal is the static nature of traditional stage scenery. Dramatic scripts often reveal the emotional metamorphosis of their characters. In this way play performances are active works of art. They exist in real-time. How much more powerful could a performance be if the environment of the play could be similarly active? It could then change with, or in contrast to, the emotional life of the characters. Virtual reality, or VR, is one very potent means of achieving these ends.

Certainly, there are a host of practical reasons for using virtual reality as a scenic medium. Scene shifts can be performed in the blink of an eye with little effort. VR scenery is ultimately portable, entire productions being created with a computer and a video projector. Fantastic special effects can be achieved with no extra cost, special equipment, or danger to the performers. But the real power of VR scenery is its malleable nature. VR scenic environments can move, grow or otherwise change in order to reflect the development of the drama.

### **2 History of VR Theatre at the University of Kansas**

The development of virtual reality-based scenography at the University of Kansas evolved over a period of many years as techniques were learned and technologies came available. A series of increasingly sophisticated laboratory experiments and resulting theatrical productions utilized emerging technologies and applications and became the building blocks for those experiments that would follow. In order to facilitate the work, 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 scenography of traditional stage productions. Computers were used to create technical drawings for scenery, lighting, stage properties, and costume patterns. After the computer proved its worth in creating these mechanically based graphics, the tests were expanded to include more artistically conceived graphics such as costume renderings, scenic sketches, and lighting storyboards. It was concluded that computer-generated images (CGI) graphics could serve a production as well as traditional design media. In fact, these CAD tools are now commonly used by theatre artists all over the world.

The logical progression of our experiments was to create 3-dimensional scenic models on the computer using typical modeling applications. As this new technique was being explored, new software tools became commercially available that would allow the user to not only create and render models but change the viewpoint of the 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 a defining characteristic of virtual reality (VR). At this point, the value of VR systems to the stage designer was becoming evident.

Later, it was decided to devise methods to render walkthroughs life-size that more accurately represent the appearance of the proposed scenery 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 a sense of immersion in the virtual environment. This sense of immersion is another defining characteristic of what is generally considered to be virtual reality. Although it was determined that the life-size projections were too cumbersome to be of practical use to a working designer, they did provide inspiration for an idea that we would spend the remainder of the decade developing. If virtual scenery could be projected life-size on the stage, rendering the illusion of a stage set, couldn't those projections serve as the actual scenery for future productions?

## 2.2 *The Adding Machine*

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 became another component of collaborative theatre art. By our current standards, the technology used in this production was rather crude. But in spite of this, or perhaps because of it, the concepts explored in the production were some of the best we have ever achieved.

## 2.3 *Wings*

The second experimental VR production was Arthur Kopit's *Wings*. The aim of this experiment was to build upon the technology and techniques discovered during production of *The Adding Machine* but enhance the sense of immersion for the audience. In addition to using the computer graphic systems developed for *The Adding Machine*, we 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 simultaneously presented with computer graphics and live video images projected within the HMD. Symbolic devices, realistic locals, expressionist images, or even close-ups of the actors were superimposed over the audience's view of the actors.

## 2.4 *Tesla Electric*

The third major VR/Theatre production at the University of Kansas was a departure from our previous

commitment to real-time virtual scenic environments. In *Tesla Electric* we experimented with a new technique of immersing an audience into a virtual environment. In our first two productions, kinetic, real-time graphics gave our audience an illusion of physically moving through the story along with the on-stage characters. In order to generate smoothly moving real-time animation of the virtual worlds, the detail and complexity of the scenes was severely limited. For *Tesla Electric* we reversed the principle and created computer generated scenes that were not capable of being navigated in real-time but were lavishly detailed and textured. Instead of being presented in real-time through the use of a computer, the scenic images were rendered in very high resolution and printed onto 35mm slides. In order to add animation to the otherwise static scenes, animated objects and special lighting effects were superimposed over the projected environments.

In order to maximize the illusion of immersion, the scenic elements were projected onto a wide panoramic triple screen giving the audience a horizontal field of view of approximately 160 degrees. Again, we employed stereo imaging so that the audience saw the scenes in 3-Dimensions with the aid of special 3-D "sunglasses". Creating stereoscopic images for three screens meant that six images were needed for each scene. To achieve the highest quality of computer graphics possible, much of the rendering was done with Radiance. Radiance is a Unix based application that renders similarly to common ray-tracing programs but calculates the lighting of the scene much more accurately.

## 2.5 *Machinal*

The 1999 production of Sophie Treadwell's *Machinal* returned us to the use of real-time graphics, drawing upon, and further refining 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.

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.

While the audience interface was very similar to that used in *The Adding Machine*, during the intervening 5 years the technologies that are available to us improved dramatically. Meanwhile, our subsequent experimental productions had greatly enhanced our understanding of the craft of VR theatre. The result was that *Machinal* had a much more polished look than any previous production. Faster computers were running detailed simulations smoothly. Scenic environments were filled with animated objects, special effects, and dramatic lighting.

## 3 Expressionism and Virtual Reality

Our first VR/Theatre production, *The Adding Machine*, is generally recognized to belong in the artistic style classification of expressionism. That is to say that the artistic devices within the play are used to reveal the emotional life of the main character rather than the outer, realistic events of his life. Typical of this style, the settings of the play are not realistic. Instead, they are fantastic, emotionally charged, and are fluidly changeable. The qualities that define it as an expressionist theatre piece are the same qualities that led us to choose it as a fitting vehicle for our first foray into virtual reality stage settings. We were looking for a script that would use VR's unique ability to create environments that are not limited to the laws of physics or of traditional stage technologies. As a result, we discovered that VR is ideally suited to convey expressionist themes of emotion and psychology.

Virtual reality simulations are fluidly constructed. Like our thoughts and emotions, they are ephemeral constructs that only exist for fleeting moments. They have no basis in the physical world. They do not exist before they are accessed by a user, and in fact, only exist in so much as our perceptions of them will admit to their existence. Similarly, thoughts and VR experiences can change in an instant. Even if the change in a simulation is carefully planned and rehearsed it still has the appearance of spontaneity.

Conversely, traditional stage sets are, by necessity, physical constructs. A physical setting designed to illustrate

a character's thought processes betrays itself by the fact that it obviously existed before the thought occurred and will continue to exist long after the thoughts and emotions that defined it have ceased. Even the most lavish traditional settings have severe limitations on how much they can change during a performance. And, because of the physical scenery that must exist to effect a change, changes in traditional productions reveal themselves to be to be premeditated, making the character's choices seem inevitable and robbing the play of suspense.

One of the first scenes to ever be staged with VR technology remains one of the best examples of its potential. In the second scene of *The Adding Machine* the lead character, Zero, is fired by his boss. At the beginning of this scene, Zero is hard at work adding numbers while his coworker, Daisy, reads them off. Projected onto a rear-projection screen behind them is a virtual environment representing the counting room 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, each speaking a dream monologue. However, the actor's shadows remain in their original positions. This effect was used to visually demonstrate that the characters had not actually left their work and the wandering movement of the actors was psychological. Simultaneously, the virtual office is moved far into the background, becoming smaller and smaller, again indicating that the character's minds have drifted from their tasks. Later in the scene, Zero meets with his Boss, portrayed by an actor who performed 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. At the conclusion of the scene, Zero is fired from his job by the Boss, who's laughing face fills the entire screen.

In scene three VR's unique ability was used again to illustrate Zero's changing state of mind. When a dazed Zero returns home after killing his boss, the furniture is floating in mid-air and the walls of his living room are spinning and tilting wildly. Guests that drop by appear onscreen as faces that pop in and out as Zero's concentration drifts in and out. In a later scene at the prison, Zero daydreams of past excursions to the beach and the audience travels there with him, only to be wrenched back to his cell as the daydream ends.

### 3.2 Expressionism in *Wings*

The script of *Wings* is not at first glance expressionistic. In fact, it appears decidedly realistic. The point of the play is to realistically depict Helen's (the lead character) crisis as she suffers a stroke and struggles to overcome the handicap of her confused senses. However, this can be viewed as an instance of expressionism in the guise of realism. Although the play is used as a means to explore a very real physiological phenomenon, the audience is still being presented with a view of the inner, psychological, and emotional state of the character.

By equipping the audience with i-glasses! we sought to devise an exciting and innovative method of communicating the main character's chaotic state of mind as she suffers a stroke and fights for recovery. In traditional stagings of the play, the audience is asked to sympathize with Emily indirectly, by seeing how she reacts to her situation. We know she is confused because she acts confused. We know that the bright red color of the flowers overwhelms her senses because we see her shield her eyes from them. In our VR production, the audience empathized with Emily directly by seeing what she saw and hearing what she heard. We knew the hospital was confusing and frustrating because we saw fractured and distorted images of rooms and corridors just as she did. The bright red flowers assail our senses, growing in intensity and size for us just as they did for her.

## 4 Realism in *Machinal*

*Machinal* is essentially a biographic play about the life and achievements of inventor Nikola Tesla. While the play's characters do demonstrate a full range of dramatic emotions, the audience is not invited into the mind's eye of any character. For our production, it would have been possible to twist the style of production to that of expressionism, but our intent was to determine how we might use VR technology to render a realistic setting. Our aim was to create a suitably immersive virtual environment for the play. Further, we sought to combine traditional theatre conventions of the audience's willing suspension of disbelief and the missing "fourth wall" with new media technology to create a convincingly realistic setting suitable for the play. As mentioned earlier, real-time simulations gave way to static, highly detailed realistic images. The final configuration of the scenery closely resembled that of traditional settings albeit with the ability to change locales instantaneously.

The illusion of reality was incredibly convincing. The simulated 3-dimensionality of the scenes provided an illusion of depth that was greater than even real scenery could offer. Due to radiance rendering, the lighting and textures in the scene were produced with incredible accuracy. With only the slightest help from the audience's imagination, it was easy to believe one was looking out over Thomas Edison's laboratory, George Westinghouse's factory, or, at the very least, actual stage sets based on those locales.

Like any traditional setting, colors and textures were carefully chosen to lend the proper atmosphere to each scene. Certain objects were incorporated to act as symbols for themes woven through the text. In a cinematic fashion, the viewpoints of each computer rendered image were also carefully chosen to increase the emotional impact of the scenery. All in all, it was a very successful production as compared to a traditional rendering of the same play. However, something seemed to be missing.

In the attempt to create a realistic environment, VR's unique ability to create expressionistic environments was not utilized. The projected scenery sat unmoving and could, for all practical purposes, have been made of wood and canvas. There were many opportunities throughout the script to use VR in an expressive manner, but once it was decided to forgo real-time simulation, those moments were lost. The sense of suspense that had accompanied our earlier productions was not present in *Tesla Electric*. The ability of the audience to directly discover a character's point of view disappeared. The production had turned from a shared experience to an illustrated one.

Certainly, the production was enjoyable, but experience with earlier productions indicated that it could have been much more so. With many realistic theatre productions, an audience will tend to notice the design elements for the first few minutes of a performance. After that, their attention is drawn to the only moving objects on the stage, the actors. Unless there is a noticeable change in the scene, it will drift into ambiguity. At this point, the environment loses much of its ability to communicate the themes of the production. In this way, realism replicates the conditions of real life, fittingly as that is, by definition, its purpose. Most of us do not take active notice of our physical surroundings for a great length of time. At some point, they stop affecting our moods and perceptions and recede from our attention. In a theatrical production, the scenery must work with all other production elements to state and reinforce the themes of the play. It will not do for it to be easily dismissed.

In this instance, it appears that an increase in the number of polygons in a computer simulation, or an improvement in the number and quality of textures does not contribute to the expressiveness of the environment as much as the real-time interactivity of a VR simulation. The real-time environments of our earlier productions proved to be more engaging than *Tesla Electric*'s static scenes even though the graphic quality was obviously inferior.

## Conclusion

The effectiveness of virtual reality as an artistic medium does not depend on the number of polygons that can be rendered per second or the bit depth of textures in a simulation. The quality that separates VR from other graphic forms lies less in the quality or realism of the images it produces and more in the ability to transform itself and offer a dynamic experience to the user. Most art forms seek to illustrate or comment on the human condition in one way or another. In the theatre, stories are told of characters whose lives are changed during the duration of the performance. As a vehicle of expressionism, VR scenery can dramatically illustrate the emotional progression of those characters during the course of the play. Its ethereal nature wraps a production in a seemingly magical atmosphere that is tied directly to the life span of the performance.

The problem of having to choose between a smooth simulation and detailed realistic graphics may already be a thing of the past. Improvements in computer and VR technology already make it possible for a production design to use high-quality graphics in real-time. As usual, advances in simulation technology are used in commercial applications first. It is only later, when costs come down that they become affordable to theatre groups. It is still important, however, to remember the lessons learned in previous productions and focus on the kinetic properties of VR scenery.

The 1999 VR/Theatre production of Sophie Treadwell's *Machinal* at the University of Kansas used computers, projectors and software greatly improved over that used in past experiments. The production explored the new tools and new methods of projection and styles of presentation. The simulations used in the *Machinal* were technically more proficient than those of earlier productions, but the detail of the graphics was not significantly

different from that of *Wings* or *The Adding Machine*. A new VR/Theatre treatment of Shakespeare's *A Midsummer Night's Dream* is currently underway at the University of Kent at Canterbury and will be performed in late June 2000. This production will use similarly improved systems and, in addition, will focus on developing techniques that will introduce added detail to the scenery simulations without sacrificing the real-time interactivity that makes them powerful tools of expressionism.