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A Guide to Design and Production for the Video Centric Performance

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A Guide to Design and Production for the Video Centric Performance

by

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Abstract

A Guide to Design and Production for the Video Centric Performance

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As modern technologies increase the capabilities of today's stage, performances have grown to incorporate the use of video as a means to transform the stage in a way never seen before. Digital tools have unlocked designer's ability to modify space and time in at the actual speed of light. While analogue film projections have been used on the stage for a number of years, it is the advent of digital video that has allowed performance art to develop a new interaction with a virtual world.

I intend to explore and document the process behind a video centric performance. In this instance, I define video centric performance as an event in which the action on stage relies on the video content in some way to create a complete performance. Through this thesis I will focus on how the evolving definition of video has created particular workflows and methodologies to help adapt digital video techniques for the stage. Using several case studies, my workflows and methodologies will be developed and formed into a single written document.

My written document is meant to be an all-encompassing guide. The goal in writing such a text is to provide single source education for artists looking to grow their understanding of video centric performances. Video production as well as stage production is a nuanced art, which can require years of practice to fully understand. Young artist may use higher education to grow their skills, or experienced professionals may use reading as a means of professional development. In both of these instances, members of the entertainment community are limited by the availability of a single source to bridge the gap between existing educational resources. Throughout the document, I avoid expanding on detailed topics that are covered by other professions, instead opting for an approach that weaves together the skills of performance artists, designers, technicians, cinematographers and animators in a way that focuses these talents towards the stage.

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RESEARCH METHODS AND GOALS: *SECTION 1*

Chapter 1: Background and Significance

There are two distinctions that make modern video centric performances possible. The first distinction is the difference between film and video. Film projection has been used since the days of Erwin Piscator in the 1920's. Since film projection relies on a physical medium that must be processed and developed before it can be played back and viewed, it has inherent limitations. A film projector creates moving pictures by shining focused light through a series of still frame images that cycle forward progressively. Once created, these filmstrips cannot be modified as they cycle through the projector. This lack of flexibility is why the distinction between film and digital video has such an impact. Digital video allows for an amount of flexibility that is more capable of matching the liveness of a stage performance.

In contrast to the rigidity of film, digital video can be modified repeatedly, non-destructively, and most importantly during the playback process. The storytelling advances that have come out of digital video technologies are beyond the scope of this writing. What is important in regards to stage productions is that video can be controlled in a way that fits into the process of stage performances. Similar to lighting, sound, and automation, video playback can be controlled through a series of cues that can be written and cued up in direct relation to the performer on stage. The interaction between video and performers creates a new visual language in a similar way to automated lighting. At its advent, automated lighting provided a completely new element to a performance.

Although stage lighting had existed long before automated lighting was developed, the new capabilities added so much complexity and flexibility that lighting grew beyond its traditional function. The movement of these units became something that could be choreographed and animated, and become part of its own stage picture. As video continues to develop, it is flexible enough that it must be seen in the same way. Video can provide image, color, and texture. The possibilities in which these styles are conveyed are so numerous that they must be directed with great care.

Of the two distinctions related to video centric performance, the first is in regards to time, or more specifically, change over time. The second distinction has much more to do with space. Feature films rely on a single flat surface to communicate a story. Filmmakers rely on their own techniques to create a sense of space, when in reality this space is only an illusion representative of the setting of the film. On stage, performers scenery and video display live together in true 3D space. Even if video projections are displayed on a single rectangular screen on stage, the screen's relationship to the performer and stage creates a 3D environment. As an example, consider the work of the company Teatro Cinema based in Santiago, Chile. Using two flat screens, the performers are able to act out a show in between the screens thereby creating an entirely new false sense of perceived space. With careful control of content, Teatro Cinema is able to put its performers inside a virtual space.

The phrase “careful control” cannot be stressed enough. While Teatro Cinema is able to create a very cinematic effect, its methodologies for creating that effect are far from standard. They achieve their effects not by playing back the same image of a setting in front of and behind a performer. They are only able to achieve their effects through careful control of foreground and background information. By timing certain projected scenic elements to move from foreground to background, they are able to create a more stunning effect. That being said, this control can only be achieved through rigorous rehearsal and experimentation. As the role of video expands on stage, so does the amount of consideration required to achieve a certain effect. The number of considerations in video design and implementation grow, and so do the demands on entertainment professionals who implement them. Demands for high level shows can be so great that traditional training in theater or film production does not suffice to prepare a designer or technician for the task at hand. Several recent texts such as *Staging the Screen* by Greg Giesekam and *Digital Performance* by Steve Dixon document the progression of film and video for the stage, but provide no preparation for aspiring professionals looking to understand the process of integrating video into performance. Through my research I will begin to document the integration process of video centric performances in a way that has not yet been provided to the entertainment community.

Chapter 2: Goals of Research

Daring performances may choose to use the latest technology to push the envelope of what can be achieved on stage. Any show wishing to adopt new technologies must have a strong fundamental understanding of the existing techniques to build from. It is my intention to document my understanding of modern techniques for implementation of video systems on stage in a way that lays a solid theoretical foundation for any future designers and technicians looking to expand their knowledge base. In my educational document, I will stay away from specific examples and document core concepts in a manner that can be relatable to both designer and technicians who are in need of a deeper understanding of video design for the stage.

I will be focus on the start to finish process of video integration. Beginning with conceptual design and concluding with final performance on stage, I will analyze proper practices, workflows and the technological concepts that help define screen space in a stage environment. In my documentation I will include chapters on the personnel required, and knowledge they must understand before taking on a project. That knowledge will be broken down to the topics of technologies used and what variables of those technologies must be factored into the planning of a successful media centric performance.

In addition to technology, one of the core concepts I will examine is the understanding of screen-space as it relates to the physical world. A key element that separates a feature film or television program from a video centric performance is the relationship of the screen to a live audience. Understanding how screen-space in postproduction relates to a dimensional environment on stage is a critical concept to document. Video systems are measured in numbers of pixels, while stage space is measure in feet and inches in the imperial system. Trying to establish the translations of one measurement into the other is a major topic in my writing. The topic goes on deeper to discus aspect ratios and the relationships between one screen to another.

My research will also document the integration of video content as a temporal medium and discuss the problems in synchronization and cueing. The change of time inherent in live performance is a major hurdle for video content. Cueing a show with video content has many nuances not only technically but also design-wise. In my writing I will cover techniques for allowing unknown clip length times as well as other topics such as programing techniques and preparing content for the cue in process. Using first hand research I have explored and documented these topics to develop my understanding of their functions on stage.

Chapter 3: Research Conducted

To created this document, I have merged knowledge gained from text based research, industry web resources, technical manuals, and case studies of production experience. I have found several books containing single chapters on the integration of video into performance, but none I have discovered go into any greater detail. *Concert Lighting third edition* covers the use of media servers, while *Freelancer's Guide to Corporate Event Design* covers some of the technical considerations required to incorporate projection screens into scenic designs. Apart from these texts I have studied several additional texts covering specific functions of the art form. These books range in topic from video production, to projection systems, while also including drafting techniques and lighting methodologies. While this reading was useful in providing hard data, the technological specifications change so quickly that the only reliable source for product information can often only be found on manufacturer's websites.

My research has included technical data and instructional manuals on current large format display systems. I used this reading as a basis for up-to-date technical capabilities of display systems and also as an example of best technical practices as written by equipment manufacturers. Trade magazines in the staging industry have also provided valuable examples of current market trends. Publications such as *Projection Lights and Staging News* (PLSN), *Live Design,* and *Projectionfreak.com* document current productions and share the details of both design and technology behind some of the world's largest productions. Having access to the processes behind mega-tours and

Broadway performances help provide perspective as to how fundamentals can be applied to larger applications that utilize many more human and financial resources.

Chapter 4: Performance Case Studies

Through my production work at The University of Texas at Austin Department of Theater and Dance, I have made several realizations in regards to the workflow of video for the stage. Video centric performances can be both generative and reactive. For example, *Oblivion's Ink*, choreographed by David Justin with lighting/video design by Ryan Andrus is an example of reactive video design. In this dance performance, the designer chose a highly integrated approach. The video content was a series of ink drops used to react to the movement of the dancers on stage. Content was then played back on an upstage rear projection (RP) screen as well as projected directly on the dancers. In this case, the video content came after the choreography. Using footage of the dance for timing and spacing, Ryan was able to concentrate ink drops to the location of the dancers over time. Ryan's careful planning in his process created a polished final result. Knowing his goals and planning around them guided his decisions. Knowing that he intended to use video as both a lighting source and an image source, he was able to plan a multi projector setup that allowed for both, and create content according to the spatial arrangement he decided upon. Using his clear concept, Ryan was able to program his content to cue along with the stage lighting to hide and reveal the video texture at specific times in the choreography.

An example of generative video is *Terminal Static* choreographed by Andy Noble with video/lighting designer by myself. The process of this dance piece was very different from the *Oblivion's Ink* example in that the video design came before the choreography. *Terminal Static* used pixel-mapping techniques to playback video on incandescent light sources. By doing this, I was able to control both lighting and space simultaneously. Using digital rendering techniques, I was able communicate this with the choreographer early in the process, and inform his workflow. With proper communication, and planning of an efficient control system, we were able to integrate our art in the tech process seamlessly. Knowing that the video playback must react to the dancer in a timely manner, I researched and chose a control system that was able to adapt cues and playback with no delay. Despite these efforts to integrate the motion, the lack of direct interactivity added a slight delay. The delay came from the human element in the system in this case. Having not provided a system for the video to react directly to the performer, I was bound by the perception of the stage manager for proper integration.

Technical implementation must be considered early along with the artistic direction of a piece. The opera cycle *New York Stories*, is a great example of this. For the production, the scenic designer had a specific visual style in mind that she designed towards. While the scenic designer’s process stuck to the concept, she did not communicate the details of the design effectively to the video team. Creating a groundplan for scenery without making considerations for video projections made it exceedingly difficult to find a setup that would meet the goals of the design team. Throughout this process, drawings became increasingly important. Rear projection was the only solution for the staging requirements of the show, and careful math had to be taken into consideration to find room to fill the screens provided by the scenic designer. The show drawings included not only groundplans, but also sections and elevations.

These helped show not only the angles at which the projections would hit, but also how the plan of projection would align with the surface with it's given aspect ratio.

New York Stories shows how spatial planning can be important, but equipment planning must be considered as well. For the grand opening of a new theater and McCallum High School in Austin, Tx two DL.2 units were chosen to project content onto the sides of the house of the theater. Not planning or testing ahead of time led to multiple problems. Without considering the specifics of the playback devices to be used, content was cut from the show that could not be formatted to be used on the device. More troubling, not testing content or technology caused the programming crew to realized on site that one of the media servers had a hardware failure and forced the media to be cut entirely from the show.

The exact equipment to be used must be researched heavily. In the case of Blurred Boundaries choreographed by professor Yacov Sharir, equipment was chosen based off of past experience rather than testing and research with the latest gear. The lack of testing and research proved problematic as the angle and brightness of the projected image degraded the quality of the media design.

Interactivity is another element that must be tested extensively. Research done by PhD student João Beira with Yacov Sharir culminated in two separate shows. *Too and For,* which used touch control software on an Apple iPad to allow João to personally interact with the performance through means of an application which controlled projections on a downstage scrim. The interaction was simple, but testing of different software versions and practice of the live control allowed for a performance that organically flowed together between video projections and dancers on stage. *3D Embodied* was a dance piece created by the same duo, but with the help of several additional collaborators. The setup in this case involved much more hardware to create an interactive setup. With a Kinect camera, and biometric feedback being fed wirelessly back to a server, the team created a system whereby both audio and video reacted to performers on stage. While the technology was carefully planned, and did work on a technical level, the complexity of the system allowed for far less flexibility. With limited ability to change the content of the show, the final product lacked the appearance of interactivity despite its integration into the show. The interactivity was used in so many different ways; it was unclear which visual elements were being controlled.

Artistic and technical integration must be considered at the creation of the piece. *Elvis Machine* was a show conceived by Austin based ensemble The Duplicates and was a live stage musical performed in a drive-in movie environment. Basing the show around the drive-in feel created a situation in which the video content was very relevant to what was happening on stage. The screen established itself by playing back retro promotional material from the heyday of the drive-in theater. Later on in the show, the media on screen diverged to follow the storyline written by the creative team. The screen never went to black. At times it was used to directly interact with the characters; in one instance a projected Elvis mannequin moved its limbs to respond to the lead character. Even when not used as a story point, the screen was used to convey style and location information that kept it relevant and integrated into the performance.

There are times when the integration of video into a performance can be a lengthy process. *Lilith* is a dance piece developed by Chell Parkins and centered on a character immersed in technologies. As an early contributor in the process, I was able to provide ideas as to how we can use digital methods to surround the character in technology. In lieu of true holographic effects we initially chose an abstracted means to show the intrusion of a digital character into the onstage space. For the piece I design a series of screens that, through projections, a virtual character could walk across and follow the stage performer. The challenge with this setup came mainly in the choreography. While the series of screens allowed for greater perceived movement, it also limited severely the movement of the choreography within the screen. Despite multiple workshops and several experiments, we were never able to overcome the complexities of choreographing the movements to properly interact with the screen. In the end, the idea was scrapped in favor of a more open approach: using 3D Kinect data to help create a more dimensional effect upstage of the performer.

Budget and labor are elements that require careful consideration. In the Butler School of Music production of *La Hija de Rappaccini*, scenic designer Richard Isackes designed a set that allowed for stylized projections to surround the performer on four sides. The projections were considered in the design of the set, but this was done without consulting a video engineer. Not having an experienced video engineer caused a twofold problem. In theory the setup was not complex. The bulk of the media was rear projected onto three translucent screens made of a fabric tested to take both light and projections. However, without the related math being factored in, the desired result was never able to be achieved. Scenery was designed and built before the maximum screen size could be calculated for the shallow throw distance in the stage right wing.

The second problem stemmed from the lack of project management. Video engineering was to be provided through a class project, but having no clear-cut guidance caused several factors of labor and schedule to be overlooked. Ultimately, the surrounded effect was produced, but only after large expenses, many changes, and extensive labor hours. Proper two-way communication between the scenic team and video team would have greatly helped the *Rappaccini* production.

In *The Scarlet Letter,* a new play written by Sarah Saltwick, this video/scenery communication also had strong effects on the aesthetics of the show. Scenery for the production did not include any dedicated screen surfaces as part of the design. While this approach can be used for interesting mapping effects, the design did not call for such effects. Fitting realistic images onto the set via projection proved challenging. In addition to the lack of space for video content, no tests were done to develop paint treatments suitable for both the scene designer's aesthetic and the limitations of projectors. Having such a dark paint treatment dimmed the images considerably. The brightness coupled with the busy stage picture, made any video designs difficult to read.

Chapter 5: Idealized Case Study of *In Between*

In order to flesh out the details of an idealized video centric performance, I have worked with collaborator Chris Yoo to devise and implement an original performance. This performance culminates in the form of a very personal piece of installation art. Focusing on the personal story of an individual caught in a transition between two cultural worlds, the installation uses video projections to tell the story of an unseen character.

Illustration 1: Rendering of introduction scene

Individual audience members are guided into a gray and lifeless room with a desk and chair situated right in the middle. After entering the room the audience member will begin to see diary writing appear on a diary at the desk. As the diary progresses and tells the story of the central character, the room comes alive with projected video content to represent the journey of the character in a way that allows the audience to relate their personal journey through life.

Illustration 2: Installation without projected imagery

From the start, this project was created as a video centric performance. Throughout the devising process Chris and I focused on the video elements and projection as the primary means of communication. This led us to take a unique workflow to create the installation. This workflow is the basis of a case study on video design and implementation.

Devising began with only a specific character journey in mind. Based off of the personal experiences of a Korean immigrant moving to the United States, we created an abstract story about the transition to an unfamiliar place. With the goal set of putting the audience in the shoes of this isolated character, we then designed a room that can transition from the comfort of a bedroom to a cold and isolated territory through the use of video projections. Working together through digital sharing networks we co-wrote a storyline that represented this journey both visually and through textual communication.

The workflow of the project is the central elements that I have analyzed. Starting with the devising process, Chris and I focused on visual storytelling and wrote the script first through visual descriptions and then later added in text based story elements. This order of the process is the key reason that defines this as a video centric performance. While parts of this story can be told through text or scenery, the full picture never arises without the use of projected video elements. It is video that actually is the driving element of the installation. Even the textual elements of the story are displayed through video projections in the form of the personal diary of the character.

Illustration 3: Filming real time writing of the diary

Once the script was complete, as a team we determined what physical elements would make up the setting that this installation would take place within. Based off of our goals for a personal experience, we used elements of a bedroom to represent a comfortable space. It was decided that this room would represent the abandoned room that the story's central character has left behind. That in mind, we listed some of the key elements the room may have and then selected based on their critical necessity as scenic elements, and also their usefulness for mapping purposes. Using this list, a full 3D model of the space was created in Vectorworks. The model included perspective views from the seating position, allowing not only for scenic design, but also gave us a better sense of how the spacing of furniture would allow video mapped projections to fit into the space.

Illustration 4: Rendering of the physical space without projections

After the physical room was agreed upon, the 3D model was then used to create elevation drawings of the walls with digital accuracy that would later form the foundation of our media creation. Since the model was created from the start in three dimensions, the projector tools in Vectorworks could be used to align all 5 projectors in space and view their cone of light as it strikes the walls. Having this powerful tool allowed me to create a second set of drawings that I refer to as resolution diagrams. Using the defined image size in relation to each wall, I was able to determine how the resolutions of each projector would display in the relation to the dimensional measurements of the walls using only algebra. Combining the pixel dimensions I then had my starting resolution from which all of my adobe files would be created. Overlaying into these master files are then drawings of the wall elevations. The combination of the two became the canvas from which my still artists were to work.

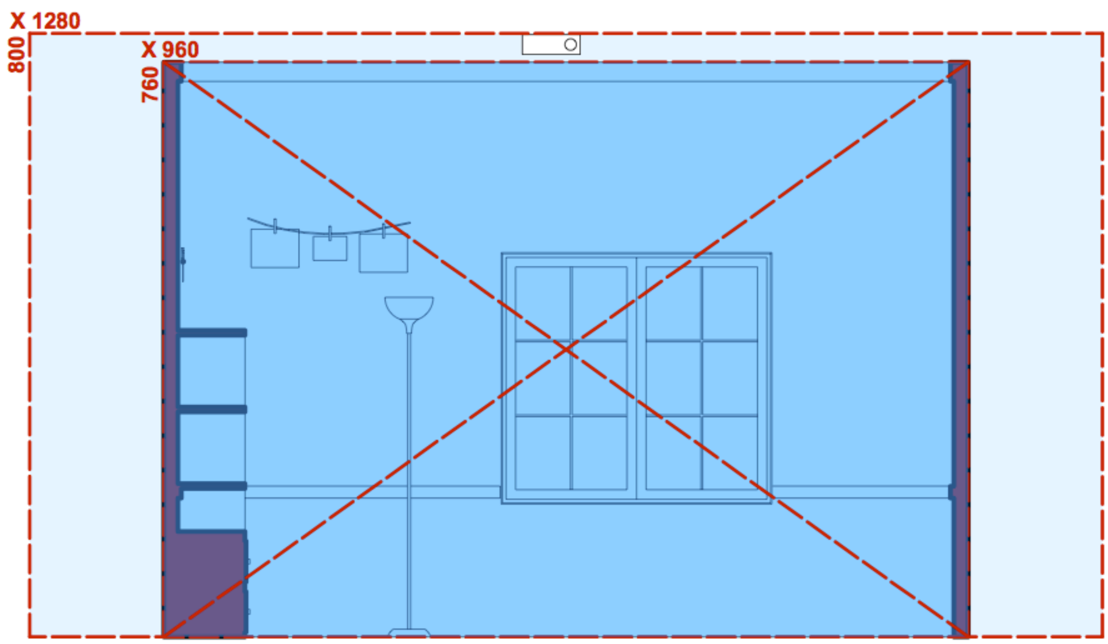

Illustration 5: Resolution Diagram for right wall

Having the constraints of the visual canvas clearly defined, we then moved on to a more clear definition of the style our content would take on. Using standard visual research practice, the creative team combined agreeable images to represent, style, color, texture, and also key visual elements. It was then up to Chris Yoo as the principle scenographer to create abstract renderings to represent the key locations that would be traveled to in the journey of the installation. These were not detailed or mapped to the scenery, but gave the still artist a clear image of the shapes and structure of what is to be formed over the length of the piece.

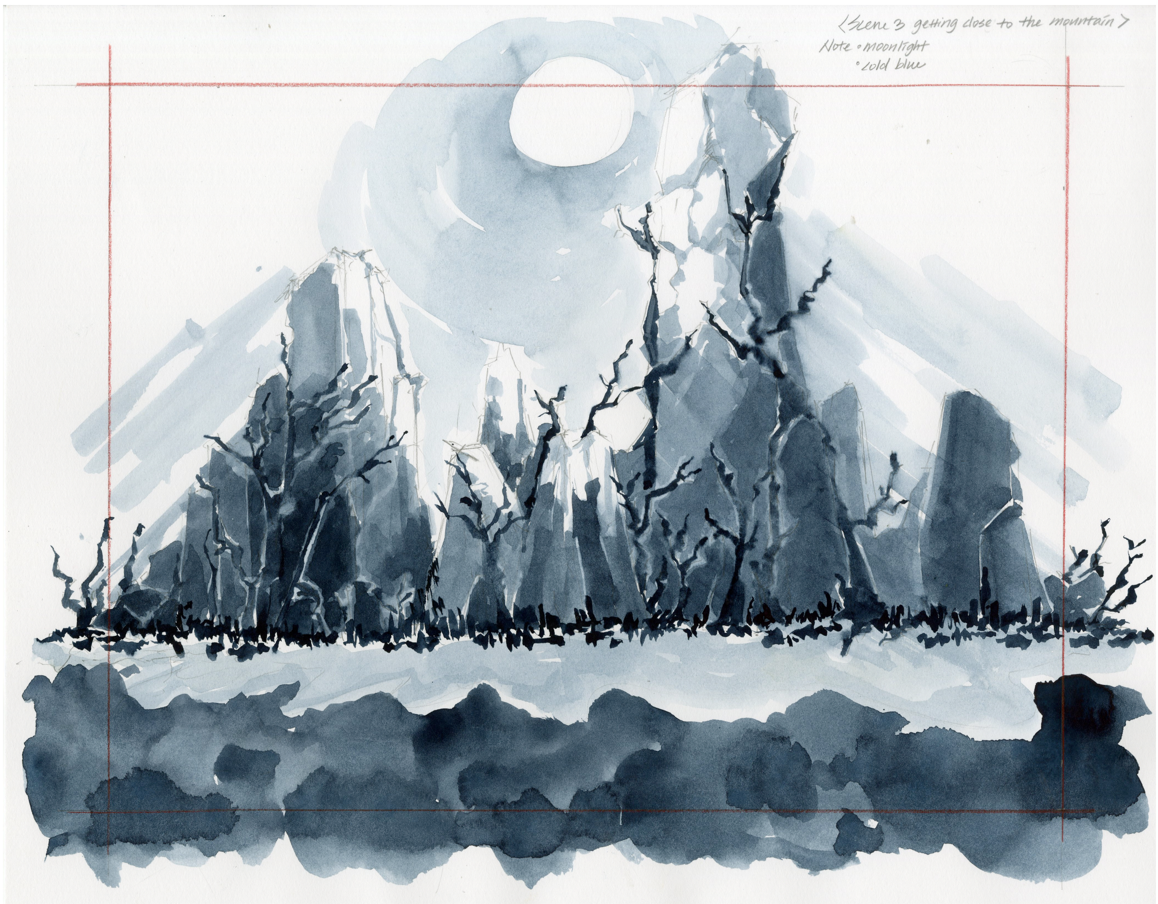

Illustration 6: Concept art from Chris Yoo

The Yoo renderings were then passed off to Stephanie Busing who has experience not only in content creation, but also has skills as a scenic charge. Stephanie chose to use an analogue/digital hybrid technique that provided a stunning effect. Various elements of the video content were painted with guash paint, one element at a time, and then individually digitized with a high-resolution scanner. Keeping these elements separate, she was then able to insert them into Photoshop as separate layers to create one composite image. This composite image had the beauty of hand rendered artwork, while still retaining the benefits digital content including fast animation, and ease of revision. The artwork was revised several times, and different elements were added in individual scenes to allow for the changing of the still art over time via animation.

Illustration 7: The artwork being painted in pieces

Illustration 8: A final piece of painted art after being assemble in Photoshop

Having the still art in such an easy to use format helped eased the animation process considerably. Not only were Adobe documents organized and easy to manage, but the visual design also included an inherent movement designed into it. To add some dimension to these animated movement of 2D elements, more modern animations were then added in. Some things such as fog and haze were added in to provide atmosphere, while some other elements were added to incorporate more organic and dramatically interesting forms of movement. Most notably, beautiful growing trees were added in great detail to the final scene to transform the perception of the location.

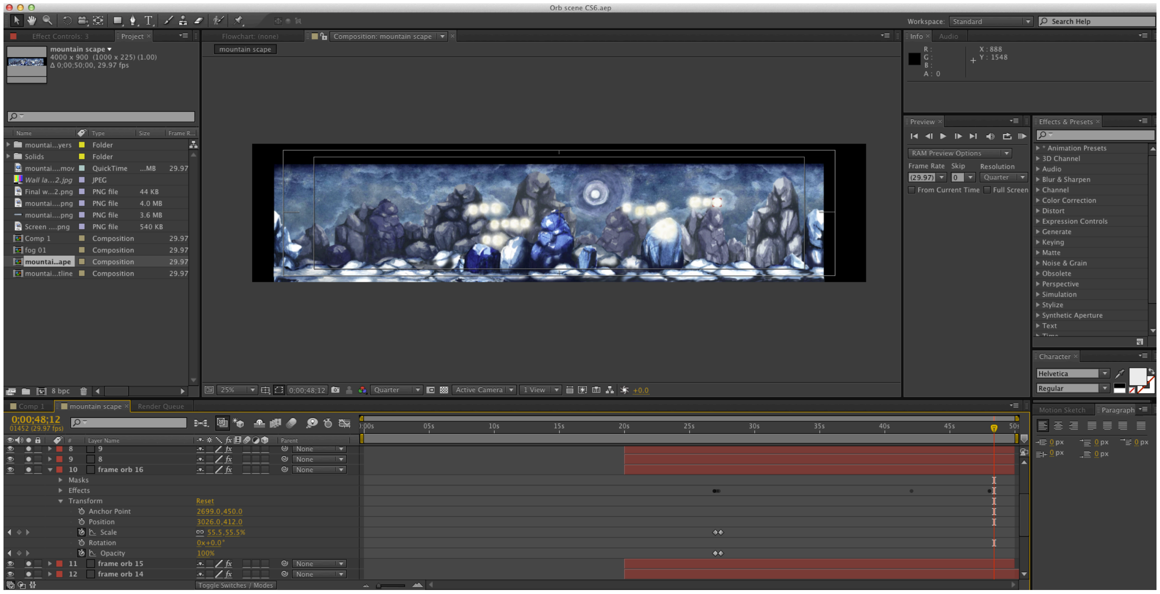

Illustration 9: Sample of one of the many Aftereffects projects used to created the content

The painted elements gave a very nice picture book journey to the story, but since this story is based on a real human being, we also decided that we must also incorporate the use of recording technology to lend credibility for certain aspects of realism. We began by using video recording equipment to capture realistic movements of the shadowed figure at the desk. The footage was processed to match the more cartoonish quality of the rest of the production, but maintained realistic human movements that would be otherwise difficult to recreate. Similar methods were used to recreate the monstrous figures in the mountain scene. Most importantly, real live handwriting was captured to recreate the writings in the diary. This is the key entrance into the story and was designed to represent the story as if it was developing in front of the audience member's eyes. In addition to video recording, photo shoots were planned and designed to capture ephemeral flashback memories of the character as she reminisces in the diary.

While there are some sound effects, most of the auditory experience is through audio recording techniques. In terms of process, these recordings were taken with specifically timed cues in mind and played a major factor in how the story unfolded. To maintain a natural effect, the recorded readings, visual diary video, and artistic story representations all had to be timed together to all function in the same space a synchronized times. Other elements had to be carefully timed and planned including simple 4D effects such as a box fan, but also creative use of traditional lighting techniques. During certain reveals in the video content, the lighting console is timed and coordinated to react based off of the Isadora playback system. The most important incorporation of this effect is the ending moment. At the point where the character accepts her journey into this new world, the magical door representing discovery and acceptance is revealed in front of the audience and invites the audience to symbolically exit out of the hidden physical door in the scenery. A video image of a door is projected onto the hidden door, while simultaneously lighting behind the door glows through the small seems around the door, cueing the audience to realize this door is more than effect, but also a journey that weaves into their own lives.

Illustration 10: Recording of mountain people dialogue

Having such a diverse array of content provided for a good bit of work simply getting the entire series into one single storyline. To do be successful at this, it was important that we stayed true to our final output resolution in our master compositions. Higher resolution pictures and videos were brought in, but always in the scale and aspect ratio of our total 4 screen output. Other methods were used such as layering, transparencies, keying, and blending modes; all of these lay within our final Adobe Premiere master composite file. Using this master file, with all video imagery together, in time, in one place we could then prepare it for playback from the cueing system.

The content was split apart for playback from the five separate projectors. This means there were five individual videos playing through five unique video outputs. Having the five clips helped manage file size and allowed the computer hardware to handle the file much easier. The most critical aspect of this was having the ability to warp and fine tune the alignment of every projection surface. Some software allows for this with any file, but splitting them allows for more precise control and smoother playback at higher resolution. All video content was rendered to match the exact native output of the projector in a video compression free of processor intensive intra-frame compression. These factors make a huge difference when managing multiple displays at higher resolutions.

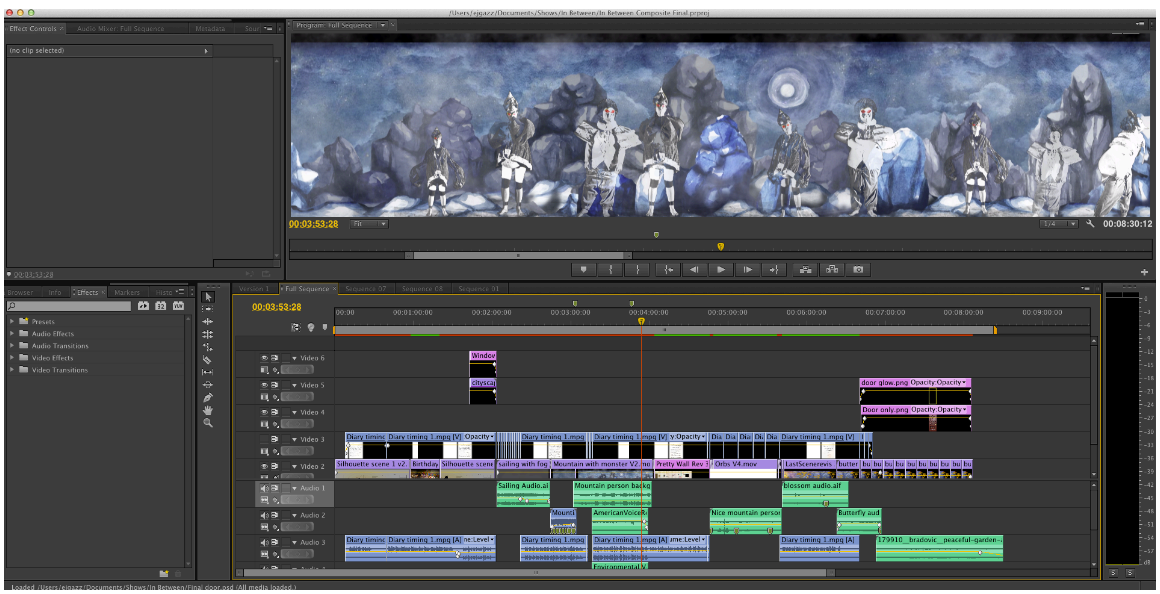

Illustration 11: Master Premiere file with all content assembled

In order to get to this point, a great deal of organization was required beforehand. Before any content was rendered, a storyboard was created alongside of the script providing specific visuals and timeline information that helped create a series of content that worked in concert with each other. While there may have been much room for improvement in the storyboard for this project, having a pre-determined timeline and second-count for animations and transitions was vital later in the process. Having this organization allowed for a situation in which five separate team members were creating completely separate media content at separate locations, without constant communication or oversight.

While the process was not flawless in our situation, we had an overall clean workflow, with only a few hiccups due to miscommunications. To help avoid these miscues, the sharing of content had to be closely regimented. As we typically only met once a week during the semester-long process, organization again was key. The sharing of media and documentation was done primarily through the dropbox service. This service automatically synchronizes select folders amongst various computers regardless of where they originate. Dropbox is so automated that two things quickly became apparent. First off, it must be made clear when files are updated or otherwise ready to be used by others. Secondly, a clear file naming convention is critical. Without a system of dating or revision numbers in files, it can be nearly impossible to separate edits form multiple users without constant electronic communication. The clearer the file name, the less questions that need to be asked later down the line, and more importantly the less mistakes can be made.

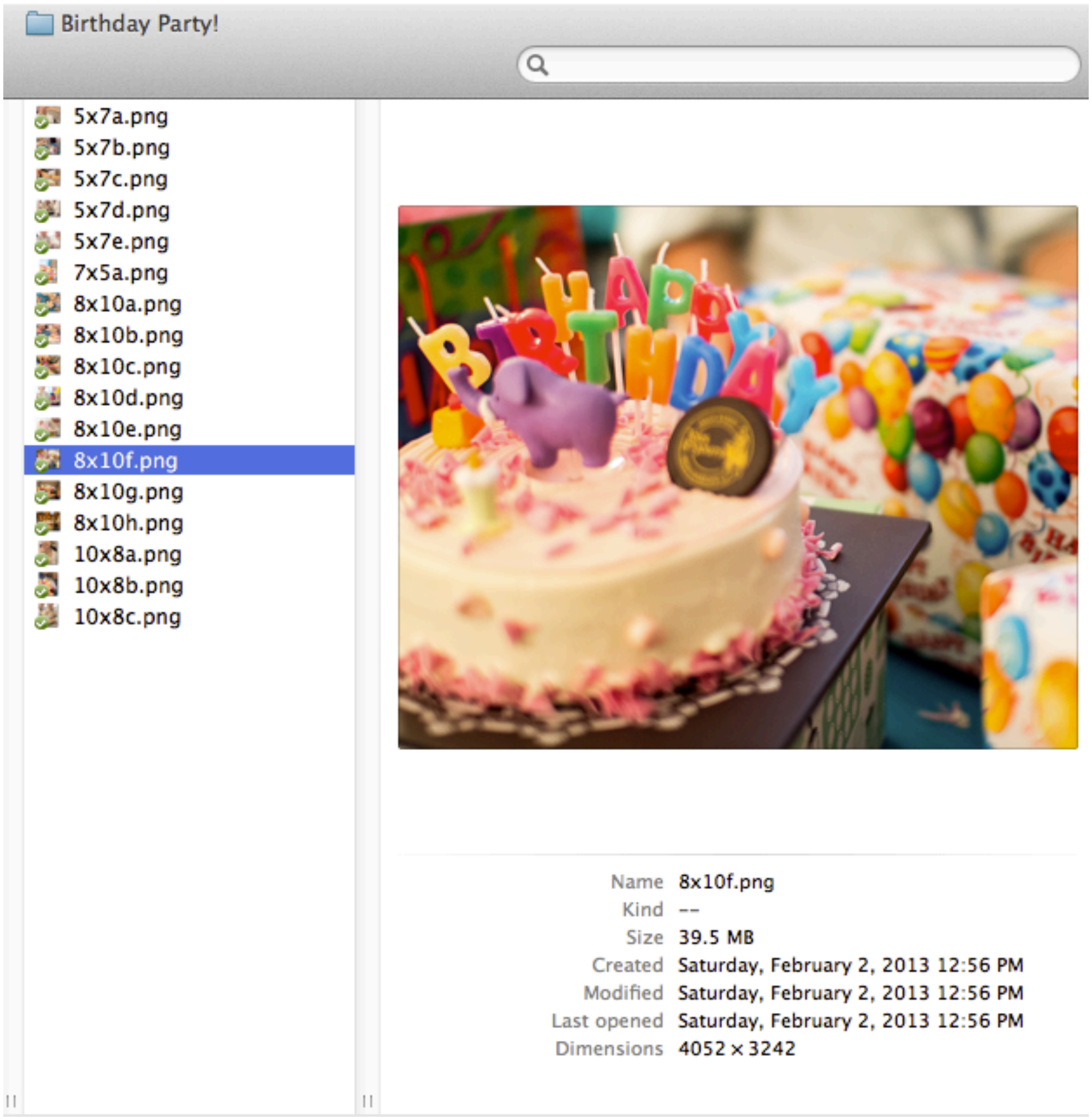

Illustration 12: Example of file naming structures

As the content developed within the space of our workstations, the installation environment began to blossom around it. With extensive testing we began to have a solid physical form for the piece. We tested things like reflectance and texture for the wall treatment, as well as various papers and vellums for the magic of the rear projection diary. As every piece was built it was tested, allowing for a necessity invented short load-in process. Knowing that the control and programing of the show would take some time, as much as was possible was tested beforehand so that the integration process could take place smoothly in the single day we had allotted to us. When it came time to load in, the process was clean and free of challenges. Having such a well articulating projector mount allowed for fast focusing of the four overhead projectors. In contrast, the sound system was untested and slowed progress almost immediately upon integration into the playback system.

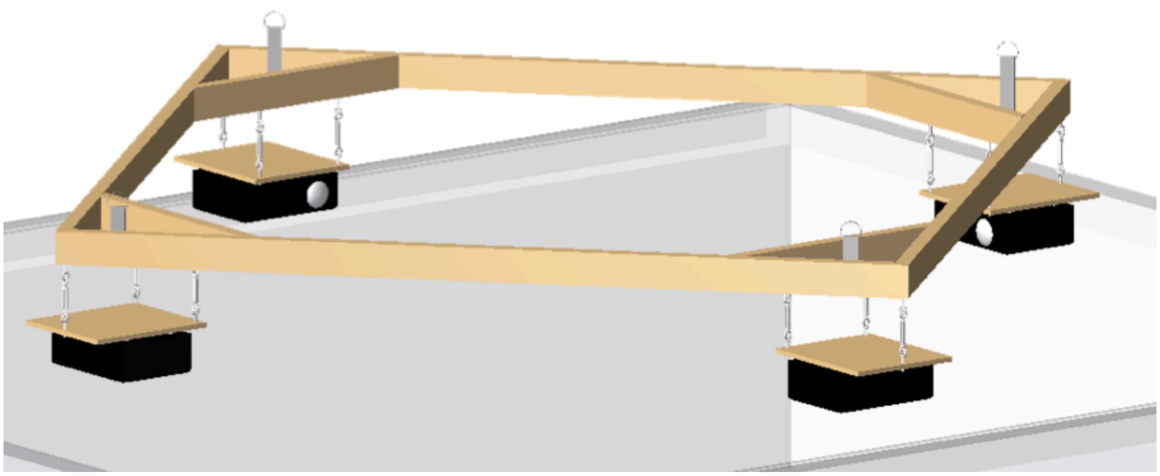

Illustration 13:   Custom built articulating projector mount

In the alignment of the mapped content, precision became key. After the first hour of finessing the alignment, I realized that although the content was aligned well left to right, there were a number of issues top to bottom. Between scenes some of the content appeared to jump up or down by two to three inches. Having compiled all of the scenes into a single Adobe Premiere project, I used my master template to align the various scenes ahead of time. I have since realized that the 4,000 pixel width of the project made it difficult to me to see small details when the display was shrunk to fit the full canvas in the preview window. Having my preview scaled down made it easy for me to miss a small misalignment of two to three pixels, which would then translate to my height difference in the final product. Splitting the difference gave an acceptable final result and saved the team from hours of render time. Content was planned well enough that no edits had to be made in the space. Before the cue-in, I timed the full render process in order to weigh the pros and cons of re-rendering what in this case would be a five hour process. Another small stumbling point was the management of system resources when playing back in the Isadora system. Having five displays running off of a single CPU was a major drain on the system. While the content was exported in the recommended photo-jpeg format, the length of the show created a file size of nearly 30 gigabytes. What this size did was prevent us from loading the show content into the 16 gigabytes of available RAM installed in our computer. Isadora was able to play back the content and remain stable, but it did cut the playback frame rate of the final output. The smaller frame rate was within a certain tolerance, but was much more noticeable in the confined space of the room.

Illustration 14: Isadora programming during the cue build process

The show control aspect of the system ran smoothly, and *In Between* ran for four days without a system crash or need for human oversight. After the first day, it took only an hour of work notes to fine tune the show. After analyzing the final product, I made small tweaks to sound levels, lighting levels, and projector brightness/contrast settings. With those small adjustments the show was complete and well received. Written feedback from the installation was overwhelmingly positive, and photographs of the production came out pristine.

Illustration 15: An image from the completed installation

FINDINGS AND DESCRIPTION OF PROCESS: *SECTION 2*

Chapter 6: Collaboration, Concept, and Expectations

I start this document by asking: What can video do for a stage production? Stage productions themselves can vary so wildly. Events such as concerts, theatrical productions, opera, dance, corporate events, installation art, houses of worship, and club environments all have their own ways of incorporating digital video into their respective fields. What all of these events have in common is the human element. Feature films rely on only a screen to communicate an idea or story. Stage productions using video rely on video to support other elements such as live music or dance. The design of video on stage can be an integral component providing essential information for a production, or it can be a support device to reinforce the communication of an actor or presenter. In all of these cases, a concept must be developed to dictate how digital video is to be used in the production.

A successful video centric performance adopts video into the creation process at the earliest possible time. In visual design this entails rendering screens and suggested content into drawings of the stage picture. Like scenery, visual design for video must consider how it functions in addition to how it looks on stage. Scenery must be planned for interaction with performers and for change over time. These changes and interactions must be planned together for proper integration. Changes may be more than just content on a screen, but may also include projection mapping on the scenery. All of these thoughts must be processed together with the creative team as the show is being developed

Developing a new show such as a theatrical drama follows the same rules of early adoption into the creation process. While video design can add to existing storylines, the writing of video into a new script helps create a performance with much more clarity. When the video is written into the story it can be part of the story, or function as an effect in a particular scene. Without writing video into the process, extra care must to taken to adapt to the existing needs of a production. In an event, collaboration is key in this step. A well put-together team can integrate all elements of design into a production and video design in no different in that regard. Regular meetings with writers, artistic directors, designers and video professionals will help apply video in the most show appropriate means possible. Together, with a clear concept in mind, the real process begins.

Video unlocks so many possibilities for the stage. Before delving into the fire pit, understand that there are many myths surrounding video production for the stage. Early mistakes in companies new to video production include making assumptions about the cost of producing video. Smaller companies can fall into the trap of assuming that owning consumer level computers and office projectors qualifies them to produce video for the stage. Modern consumer products have made the production of video content accessible to the masses. While many computers allow for cheap or free creation of video content this does not guarantee that the desired effect can be achieve. Similarly, while an office model video projector can be purchased at a reasonable price point, that does not mean it will fill the screen space effectively. The first step in any video centric performance is understanding the scope and needs of the performance.

In that regard, an experienced video professional is the only person who can determine this point. Scene designers in an already established team may decide that a projection screen is the best way to communicate location in a fast paced show with short transitions. While the director and producer may agree, that should not automatically decide that projections are the solution. Even if the content is still imagery provided by the scenic designer, large format projections are not something that most electricians are trained to handle. Video projections do not fit neatly into other theatrical departments. If the scene designer were to specify video for a production it could be called scenery. Does that qualify a carpenter to produce it? If a lighting designer were to specify a projected effect, does that make an electrician any more qualified set up video systems? The realization must be made early on in the production process that in order for video to be added to performance, the proper personnel must be available to produce it.

Production teams new to video designs may find other surprises outside the technical challenges. After content is produced and video display devices are set up correctly, the video must be cued and tested in rehearsals. This process can be very time consuming, especially if material was not properly prepared. Video cuing and setup on its own will add to the already stressful light cue build and sound cue build. In addition to cueing prepared content, there is also the added time of cue modification. Team members used to the flexibility of lighting systems may expect video programming to be equally as flexible. Modifying video content during the technical rehearsal can require complex programming or even re-rendering and transfer of source material. Going back to source material can add not only render time but also the hassle of file transfer and importing; this is a process that does not fit into most productions timeframe.

For a video centric production to reach its maximum potential the production team must see the video plan for what it is. Staged performances will not always use video, and many producing houses will never require full time video support. In order for these producers of work to be successful they must acknowledge that video support is its own unique skill-set that requires its own supporting personnel.

Chapter 7: Organization of Workflow

DEVISING/CONCEPT DEVELOPMENT

As the first step, a sound concept will guide the process towards a defined goal. The initial development phase should include all of the big picture items that will define the project. At the start of the project, a clear concept with appropriate goals must be decided upon. Concept amounts to the major overarching idea that weaves the different elements of the project together. This concept could include a clear style choice, or a specific technique used to enhance the production. For example, a concept for a production of Dr. Jekyll and Mr. Hyde may use video specifically as a means to show the hidden sides of each split personality. Without a clearly defined concept, the use of video could simply muddy the clarity of the production.

With a concept defined, more detailed goals can be laid out about how types of video content could be used in the show. Video for video's sake would be film. That being the case, without a clear purpose for video, it just becomes the background noise of the show. The video content could be used as a storytelling device, a special effect, a communication of location, and the list goes on. Later in the process, it can be tempting to throw in new video content, but it must be part of the concept to render itself effective. The video design may have a goal of communicating the inner monologue of the characters on stage, but down the line, a director may want a scenic vista to speed a scene change. In this situation, how might an audience interpret this sudden shift? Throughout the process, be sure to serve the intentions of the project as a whole.

Design Process

Once the concept for the show has been reached, the designer can start to physicalize the design. The two most pressing decisions to make pertain to style and vehicle of visual communication. The style can be based on visual research, color pallet, or be set by the mood/tone of the production. Depending on the needs of the show any or all of these items will help develop the visual pallet of the design. When presenting early work, it is helpful to keep these style choices documented in an organized manner. A style sheet can be created with color pallet examples, textural research, key art, etc.

Unified style will keep the design coherent, but without a decision on how the visual information is presented, it will be more difficult to move forward. Like any other design element, there are building blocks to work off of. A video design could be as simple as a large RP screen upstage of the performance, or as complex as integrated 3D scenery that it video mapped. The same content could be played back on either surface, but the effect could change completely. Clouds projected on an RP screen could show passage of time, while clouds projected on the windshield of a car could represent physical movement of an object: one piece of media, two completely different outcomes. Not only can the physical space change the meaning of the video, it will also define how the media is view and created. Rules of traditional 4x3 or 16x9 frame sizes do not apply to the stage. Modular video tiles, pixel mapping, and projection mapping techniques expand video imagery to be an immersive and adaptive medium.

Moving forward with clear space and style choices, the video designer must next delve deeper into the video content that is to be created. Careful research will help clarify style, and flesh out key art and imagery that can become the basis for custom animation or artwork that will be created for the show. Key art will help to define the details of the visual style such as shape, line color and form. Key art can also provide indirect help in the form of inspiration for new or related ideas.

Once the big picture is clear, a storyboard must be created to define the individual moments within the performance. One of the properties that make video design for the stage different than film is its ability to adapt and change over time. Live performances always include a human element whether onstage or backstage. To keep a show running smoothly, there must be roadmap to follow. The map that guides the production is represented as some form of cue list. In lighting, a cue can refer to a specific look on stage, but in video it can also refer to a specific point in the show at which a change in the action of the stage takes place. The video designer must map out the entirety of the show, whether it be a corporate event, an opera, or a dance piece, the progression of video must be mapped out clearly. A concise way to do this would be through the use of a storyboard. A storyboard provides clearly rendered frames of video (through drawing, or digital techniques) in relation to where they take place in the production. To communicate as clearly as possible, these keyframes should reside within the script or outline of production, allowing for chronological points of reference. These points of reference also help flesh out temporal relationships of video content. Custom content should be created to not only match the length of scene/segment, but also be created with a safe amount of overlap to allow for small changes from on stage talent between performances.

The communication of the design for media content includes elements from both scenic design and lighting design. In order for the designer to communicate his or her final design for the show it must include visual representations of what the stage will look like during a media cue. Each cue in the cue sheet should have a rendering of the stage with the content for that specific moment on stage. Only showing photos of content or not showing full sequences can lead to serious confusion among the design team. To truly design video for the stage, content must be designed and communicated within the context of that stage. Techniques for doing this include analogue sketching all the way up to 3D digital renderings of the stage with still or moving images representing particular video cues. Depending on how much detail is created in this phase, some of this rendering work could move on to become some of the realized content on stage.

COLLABORATION

No stage designer works in a vacuum, so the video design must work in tandem with other design element. Artistically, this means working together to present a clean and unified style. Practically this means coordinating a group effort to ensure no one design element impedes another. In the world of video, the video designer is often at the mercy of the lighting or scenic designer. Without a practical place to use a projection screen or video wall, the most beautifully crafted video content could be rendered useless. The video designer must be aware of his/her needs and communicate those needs to the rest of the production team. Those needs include a screen of appropriate brightness to work with lighting on stage, and a screen surface that is achievable with available staging technology. In the case of projection this includes allowing ample room for the projector's throw distance and also selection a screen surface with appropriate relectance properties.

Outside of design elements, the video designer may have to coordinate with the artistic director or on stage talent. Video content may be specific to certain actions on stage, and depending on the circumstances, that may require extra rehearsals with performers, or additional considerations on how the show is cued.

Having a clear design in hand, it is then up to the video engineering team to realize the ideas of the designer. An old saying goes "anything is possible with enough time, labor, or money". While that is hard to prove, more often some, if not all of these factors can be very limiting in a production. The first responsibility of the video engineer is to determine if the design is possible with the resources available. This includes specifying what video gear is required, what physical requirements of the venue are factors, what costs the installation entails, and what labor needs must be met. Details are critical at this stage. Appropriate projector, screens, and media servers all have a wide range of features and specifications that can easily have a negative effect on the design if not properly chosen. The video engineer must create a series of paperwork that explains the entire installation in complete detail.

A detailed tech packet from a video engineer would include groundplans of equipment placement and cable paths, equipment lists specifying what is needed for how long and at what rate, detailed budget sheets, hanging diagrams for projectors and other display devices, and system diagrams documenting the signal path in flowchart form. The system diagram should include every piece of the system, how it is connected, and what cables/adapter are required to connect every component of the system. While these drawings help the installation team, other information could become critical for the designers and content creators. A resolution diagram is incredibly useful for the creation of custom content. Resolution diagrams display in graphical form how the display devices exist in real space at a given resolution. For example, a resolution diagram could include a three-projector edge blend. Given a 200-pixel blend with HD projectors, the 5760 pixel wide image is shrunk by 400 pixels to account for the overlap between projectors. Knowing this information ahead of time can save the content creator valuable time and costly renders.

CONTENT CREATION

Depending on the scale of the project, content creation could be the sole responsibility of the designer, or a joint effort between a large team, spanning different departments and skill-sets. In simpler settings, the designer may simply find it more effective to create imagery form the storyboard based off of purchased stock content, or the designer may have the appropriate skills to create artwork from scratch. As the design needs progress, the demand on the designer may become too great. It takes much talent and training for one person to master video editing, animation, graphic arts, video production and analogue arts. It may be more effective to outsource content creation to a firm, or for the designer to hire an assistant to assist with content creation. This decision should be left up to the designer to assess what is possible within the time allotted for content creation.

To make this decision, the designer must determine what skills a required of the with the specified design. Is a film shoot required? Must a 3D video artist be called in? These choices can become expensive very quickly, so before going that route, the designer must work with his/her team to determine if any desired content could be purchased offline or composited from other found elements. In the case of in house production, not only human resources, but technical resources must be accounted for. Does the producing house own camera equipment or editing stations? Has the designer contracted out his/her own personal equipment? These are discussions to have before the start of the content production process.

Much like the installation process, the content creation process requires careful scheduling. Unlike video for film and television, video for the stage requires material to be prepared in advance for rehearsals with performers as well as advance time to cue and program the show with the live performative elements. What content is required first? How much advanced notice is needed to prepare? To allow time for previewing and testing, these questions must be carefully considered.

MEDIA FILE PROCESSING AND MANAGEMENT

Since video for the stage is broken down by cues, compiling the content requires the copying an organization of multiple, often large, digital files. These files must be named carefully to ensure that they are used appropriately and also so that they are easy to locate. The files must be managed and organized in a way that makes them clearly identifiable as to where they should be in space, time, and what iteration of that cue they are. For example a clear file name might be “cue001-DSRscreen v3.jpg”. This helps to prevent programming errors. This file name explains which cue it is in the cue sheet, what screen surface it belongs on, and which edit of that file it is. As a tech process wears on many changes may occur and many version of a cue may exist. To update cleanly, using the same file name allows the programmer to update easily or go back to previous versions if a change does not work out. When version numbers get unruly, the date of creation can also help denote correct versions.

Once organized, the files must move from creation computers to media servers. This process can include transfer to multiple devices and occasionally re-rendering of content using different compressions. Depending on hardware resources of the media server, different compressions and codecs are available for playback. In a show with many cues or multiple screens, all of these factors can create very complex files structures that must be organized and properly maintained to avoid delays in the cueing process.

Load-in process

Video equipment load-in may start before or after other design elements, but it usually cannot finish until scenery and lighting load-ins are complete. For a smooth load in, the team must be clear about what responsibilities fall to which teams. A projection screen could be handled by scenery, network cable could be handled by the electrics department, or everything could be handled by a central video team. These are all factors that come into play. This varies from production house to production house, so take care to avoid assumptions. In order to start the cueing process, the display devices must be installed, powered, have functional signal input, and be controlled by a media server. As systems scale up this may include multiple servers, additional networking devices, or custom screen surfaces. In order for the tech process to begin, the designer must have the ability to see his/her designer content on stage from the perspective of the audience. This means that appropriate gear must be set up in the venue's house to accommodate for programming and verbal communication with the rest of the design team.

To achieve this, there is often additional programming work in addition to the physical devices that must be set up in the venue. Projectors must be set, and blended, resolutions must be programmed, composite images must be created. These may be functions of the controlling media server, of the display device, or of some intermediary switcher/scaler. To ready the system, the engineer should run through appropriate color test patterns and test grids set at the correction resolution and aspect ratio of the display system. In the case of blended screens with abnormal aspect ratios, this may require creating custom test screens for that specific application.

Initial cueing first and foremost requires appropriate formatting of screen space. This means that the media server must be set to output the correct number and format of screen devices used on stage. Once that is prepared, content can be imported and media libraries can be built. With media imported this can then be set into a series of cues, or aligned within a timeline format. If organized, this process can be as quick as dropping content right in a chronological line. Once in the correct order, individual cues can be modified to align precisely in the stage space, or precisely in the time allotted. Complex cueing may require modifications such as links to interactive elements, or connections to other show control systems. With the whole show roughed in, the designer and programmer are ready for the tech process to begin.

TECHNICAL REHEARSAL PHASE

Tech rehearsals are the final phase of the project before opening. This is the time to finally view the custom content as it was meant to be seen and determine what is and is not working about the design. Determining with success of the design includes analyzing the video's interaction with performers on stage, other design elements as well as input from the artist or stage director. Cues can be modified for time and also modified to be called to go at the appropriate times on stage. A seasoned stage manager will be sure to guide this process and keep track of changes and integration of the various elements on stage. For the design the be implemented correction, the designer must be clear with the stage manager as to when certain video looks are to run within the timeline of the show. Once the entire creative team is happy with the finished product, or time runs out, it is time for the show to open

During the run of the show, an operator must be trained to not only run the cues during the show, but also to fully power up and test the system for each performance. This includes using test pattern to ensure clarity of image, and the running of cues to ensure smooth playback and uncorrupted media files. The team should always keep backups of media files and programmed show files in the event of hard drive failures in the media server system.

Chapter 8: Technical Resources for Video Centric Performances

Still Content Creation

Still imagery is the basic building block of a video design for the stage. Still image techniques often draw from the more traditional visuals arts such as drawing, painting or photography. In some cases a design may call for sourcing existing content from stock image sites or even existing artwork from a specific period or artist. There are many resources both on and offline. Stock photography websites can contain royalty-managed content, or libraries may contain more historical artifacts that can be scanned and digitized to be used in video production. Found content may also pertain to a specific location or artifact. Video projections can be used to show location, and thus still photography methods can be used to capture specific scenic elements, or other artifacts that exist in the physical world.

If still content does not exist in some way at the time of its design, then it can be created by an artist using analogue or digital techniques. Analogue drawings and paintings can be scanned as a whole, or piece by piece to fit into the digital design. If a more modern aesthetic is desired, modern digital tools can accommodate the creation of visual looks, styles and textures for a video design. Tools such as adobe Photoshop or Illustrator allow for the creation of custom rasterized imagery or vector art. These tools not only can create artwork from scratch, but can also composite it from multiple sources into one cohesive image. This applies not only for finalized content, but also for preliminary design renderings.

ANIMATED CONTENT CREATION

In the case of moving images, animation software can be used to modify imagery over time. Tools like Adobe's Aftereffects or Apple's Motion allow the creator to change nearly any property of an image over time, whether it be location, size, color, etc. The important concept that links these changes and many other aspects of video creation is keyframing. Keyframes define changes within a timeline that tell the software the starting and ending points of visual modification. For example, a blue keyframe, followed by a red keyframe a few seconds later will automatically create interpolated frames that smoothly transition between the two, adding shades of magenta between the two hues.

Animation software is not important only because it can create changes in video over time, but also because it can add a form of digital life with immense detail. Even two-dimensional effects can be created with a series of layers that orders certain elements to be shown over others. The detail only expands when 3D software is added into the mix. Software such as Autodesk's Maya and Cinema 4D allow the artist to create fully realistic digital representations of just about anything the mind could imagine. When working in 3D space entire environments, landscape, or buildings can be created with accurate textures and lighting effects. This allows the designer for great flexibility as a virtual camera can be placed anywhere within this 3D space. In the case of advanced techniques such as projection mapping this could mean creating a virtual building to be mapped and then outputting content from the perspective of where the projector will lie in relation to the buildings architecture. While these processes allow for great detail and flexibility, they also require skilled workers and high-end computer hardware to render such detailed content. This equipment and labor can prove very costly.

CONTENT CREATION THROUGH VIDEO RECORDING

There are many types of digital recording devices available as film recedes into the past. When recording live or preset scenes, equipment must be chosen to meet the needs of the capture setting. The cinematographer must take account for conditions including lighting to be used, distance from subject to lens, and necessary quality of the image to be produced.

There are many types of professional video cameras manufactured to meet very particular industry needs. Skills of the cinematographer are far more important than the capabilities of a camera, but it is important to choose the right tools for the job. In order to make the correct gear choices, there are a few details that set professional equipment apart. In order to produce a clear image some of the key factors include: lens, sensor, onboard image processor, storage medium, and a number of optional professional features.

Lens: The key function of the lens is to focus and control light coming from your subject onto the cameras imaging device. Two key factors will determine whether or not the lens will work for the shoot. Aperture determines how much light is let through the lens and is measured in f-stops. Low-light situations often require an aperture of f2.8 or better, while shoots in direct sunlight may require an aperture as small as f22. The lower the f-stop the brighter the image, and vice versa.

The focal length of the camera determines the effective range of the lens and is measured in millimeters. A wide-angle lens meant for capturing wide shots can range from 15mm-30mm, while a telephoto lens meant for capturing close up details or subjects at a great distance can go from 200mm-300mm and up. Lenses can be a fixed focal length, or can zoom between several. It is important to note that not all professional cameras allow for the option of interchangeable lenses.

Image Sensor: The image sensor is the meat of the camera. Image sensors take the place of film in the analogue world. The sensor will capture the light from the lens and create an image. Unlike lenses, sensors do not have as many variables, but a quality sensor is the root of quality image rendition. Image sensors can be measured in megapixels or resolution. This determines the maximum number of pixels that can be used to form an image, and hence the quality and level of detail in the image. A term that comes up often with DSLR sensors is full frame. Full frame sensors capture the full image being passed through the lens and are the highest quality. Crop sensors however are physically smaller sensors and capture a fraction of the image being produced by the lens, affecting the quality.

Image Processor: The image processor of a video camera determines the capabilities of the onboard brain that processes data from the sensor. The processor is a critical component because it determines the limitations of recording data on to a storage device. Some factors it controls include frame rate, resolution, compression type, etc.

Storage Medium: It is no news that digital video file sizes are a major factor in the workflow. The cinematographer must consider the length of the shoot and plan ahead to be sure storage space is available. The industry is trending towards solid-state storage, with a many options such as SD cards, compact flash cards, P2 cards and solid state drives. These devices offer fast data read/write speeds, but are often limited in size. Older formats include DV/HDV format tapes, and some devices utilize onboard hard drive storage. In a professional setting removable media is a critical factor to ensure a shoot isn't slowed down by data transfers.

Professional Features: Video cameras provide other functions besides recording an image, such as audio recording, live output and user control. When planning a shoot consider how audio will be recorded (on camera or not) and then evaluate what microphones will work with the camera or audio recording device used. Additionally if the camera is being used for live capture determine what capabilities and connections the camera provides for live output. Modern standards include HD-SDI and HDMI as live digital video streams.

While many digital cameras provide options for automatic exposure, understanding manual control of exposure will produce the best results. The three main controls for image brightness are aperture, shutter speed and ISO. Setting the aperture is typically the first step as this controls the light entering the camera as well as depth of field. ISO is the measurement of sensor sensitivity. It specifically controls how the sensor perceives the light hitting it. ISOs from 50-5120, but increasing the sensitivity will add grain to the image. The amount at which the image degrades depends in large part to the quality of the sensor being used.

NON LINEAR EDITING SYSTEMS AND VIDEO PROCESSING

Non Linear Editing (NLE) is the name for modern computer based editing systems. It allows the user to non-destructively edit in any order he/she desires. While NLE systems offer great speed and flexibility, they are also limited by the power of the computer that runs them. As is the case with all digital video, care must be taken to choose a system appropriate for the task at hand to avoid delays. The three most common editing packages include Final Cut Pro, Avid, and Premiere.

In cinematic editing, clips are organized in a logical way to convey a complete story, location, style, etc. While this can be the case, with video editing for the stage, there is the added factor of the cueing process. Unlike viewing feature films, staged video is rarely a complete start to finish package, rather a piece of the puzzle working in tandem with actors/performers on stage. To account for this major difference, editing must be compartmentalized based on either a pre-determined cue sheet, or if that is not an option a lowest common denominator method can be used. What that means is, video content to be played back must be broken up into smaller components that can be cued up individually based on the flow of the show. For example, in a dance setting, the content may require specific changes as performers enter, exit, or execute certain choreography. In this example if the choreography and video content both lasted five minutes, the artist would have to count on dancers, music, and video all being performed with second by second precision for every performance. With proper rehearsal and a talented team, that may be possible, but for the amount of certainty required for a stage production it is a safe bet to build into the performance a series of shorter video clips. Using shorter clips, software can be used to allow a human operator to recall specific clips based on the live actions being performed on stage.

To achieve a smooth cueing process, the editing of the video content must be planned out according to the design of the show. This not only means knowing what content happens when, but also considering how transitions are built in, and how to take account for time fluctuations from performance to performance. Creating content can become increasingly complex depending on the screen surface used. In a multi-screen setup, a cue could amount to playing different videos on different screens at different times. In a single-screen setup, a cue could mean added layers of video to already playing content, or it could mean a cross-dissolve between two different media files. Having a look in mind for the stage picture is important here as the style will help define how new images are added or removed.

Liveness is also and issue when editing for the stage. Actors in a drama are not (usually) robots, and hence cannot dictate the same line and the same time night after night. Consider a soliloquy with beautiful artworks projected behind the performer. The content is designed to match the mood of the character with a dramatic shift at the end of the monologue. In this scenario, if the video artwork were editing for film, the editor could edit the big shift to a specific timecode with frame by frame precision. If this same methodology were used on stage, imagine the performer taking a dramatic pause between lines. What then would happen to the content? It could jump to black, repeat, or jump to the next cue prematurely in relation to the actor. In the process of editing for the stage content must either be made to loop seamlessly from start to finish, or be long enough to avoid hitting the end of the video clip accidentally.

Loops are a strategy that allows the first and last frame of the video clip to match up precisely. If a clip of a spinning globe were used, with a starting frame of Europe in the center of the composition, that clip would be edited to end just *before* the earth completes a full rotation. That is, one frame prior to Europe reaching the center of the composition. When playing this clip back, it can be played over and over without any stuttering or perception that it may be only a few seconds of video content. Proper use of looping keeps the files sizes down and allows for maximum flexibility over time.

While all software packages have their own advantages, it is important to know what to look for in a package of video editing software. Complete video postproduction consists of much more than the cutting and splicing of video clips. A full production suite allows for editing, animation of additional original content, color grading/correction, audio master, and output software. Using the Adobe suite as and example, clips imported from a video camera can be cut together using Adobe Premiere to start. From there additional backgrounds or titles can be created in Aftereffects, and then color correction and style can be added using SpeedGrade. From there MediaEncoder can be used to render this file for multiple forms of playback.

OUTPUT OF CONTENT, ENCODING AND COMPRESSION

The nuances of rendering are often lost in the stress of waiting for the computer to complete time consuming effects. Completed video clips in any software may play back fine in the built in preview mode, but in order to use the new creation, it must first be output to its own video file. New video editors do not immediately realize that editing software creates previews based off of the many separate video files. In order to use this new compilation of clips, the computer must render and save this preview into its own digital file. In its simplest form, the rendering process creates a file matching exactly the settings defined for the sequence created in FinalCut, Avid, etc. Depending on the playback system used, and the amount of preparation in the content creation the editor may have to export a completely different file type, resolution, or codec.

Several technical aspects define how a video is played back. When working with multiples clips from different or unknown sources, care must be taken to match them to all of the following criteria.

Frame Rate: This defines how many still frames are played back in the video every second. Analogue film plays back at a rate of 24 frames per second (FPS) while video can range from 30FPS, 29.97FPS, and higher.

Resolution: Number of horizontal and vertical dots that form the image in each frame

Compression/Codec: This is the mystery puzzle piece that can cause major headaches when over looked. The compression determines how visual information is stored. It is not effective to save full uncompressed versions of high resolution files for playback. Compression is a method of consolidating redundant data in a media file, hence shrinking the size of the file. Inter-frame compression combines identical information between consecutive frames of video to decrease the amount of information stored. Intra-frame compression combines redundant pixels within individual frames to decrease file size.

File Type: File extensions on video clips act as container objects, defining how digital information in the file is to be read and is not the same as the actual method of storing visual information. Some software playback systems are limited to playback certain file types and Windows/OSX machines have limitations that prevent them from playing back each other's proprietary formats.

There is a delicate balance that determines the correct amount of compression. Overly compressed files will lose quality and will draw important processor resources to decompress the video. Files that are not compressed enough can be so large that the computer can not draw the file off of the hard drive fast enough to play it back smoothly.

APPROACHES FOR DRAWINGS AND DRAFTINGS

Staged video relies heavily on the layout and design of the stage, and in order to communicate that appropriate drawings must be created. Computer Aided Drawing (CAD) is the digital method to created accurate drawings in scaled dimensions. Draftings can communicate screen design and placement, stage design, or groundplan of the venue.

Using drafting for the purposes of video display, it can help the designer define screen size, aspect ratio, placement, and viewing angle. On the engineering end, CAD can help determine the correct lens ratio, viewing angle of a screen, or placement of a projector.

To properly communicate the video needs of a show to collaborators, the drafting must first and foremost create a relationship between the staged position of the screen and the designed video content. It must be clear enough to create a distinction between the physical elements on stage and the virtual design on the media content. On the design end, directors or choreographers must understand the what and where of what is to be projected or displayed. Technically, a TD must know the rigging requirements for the video display. Some display systems require absolute precision, and drafting must represent this need for precise placement of equipment. Especially in the case of large format projections, improperly designed rigging systems can causing major geometry issues when a projector is not mounted according to plan.

PRE-VISUALIZATION

Digital drafting and design can not only created technical drawings, but also be the basis of primary design artifacts of the show. When working with a team of collaborators, there are a number ways to share visual examples of design ideas. Properly using rendering techniques is the best way to ensure there are no surprises when the design is realized on stage.

Collaging is the most straightforward method to generate still images of design concepts. Using Adobe Photoshop or equivalents, still video imagery can be combined with drawings or renderings of the stage design to create composite image of what the stage may look like cue by cue. Photo editing allows for very beautiful or stylized renderings, but the drawback of that is that the artist's style can also create a false impression of what will end up played back on the stage. Still images are important for storyboarding out a show, but before entering the cueing process, the creative director must get more of a sense of what the moving imagery will look like.

There are a few different methods for created realistic representations of on stage media. At its simplest level, video content can be composited onto a stage rendering in video editing software rather than photo editing software. There are other programs that allow for full 3D CAD drawings to be used to render the stage with media in a virtual space. The 3D rendering method requires the most advanced skill set, and is the most labor intensive.

To truly workshop and view ideas before moving into the show's venue, scale tests are most effective. Using constructed scale models of stage scenery and a low powered projector, video content can be played back on the model in real space. In a well-organized workflow, a digital 3D file can be used to design the stage space, and if that model is followed by the content creators and model builders, it can take no time at all to then play that back in a scale test. This method works for both staged screens, and even mapping if the dimensions of the building are known. Some media server resources allow for pre-programming and visualization of media content in a virtual space.

Chapter 9: Resources for Display Systems

PROJECTORS AND LENSING

While the technique of film projection has been regularly used for the stage since the 1920's, digital video projection has only been around for the past 25 years. While there are a number of differences between film and video projections, it is important to realize that they both perform the same basic function of projecting filtered light onto a surface to form an image.

There are two methods for filtering the light to form an image. LCD projectors have been around since the 1980s. In and LCD projector, light is separated through red, green and blue dichroic filters and then sent to the LCD device to filter out light in individual pixels. The three streams of light then converge to output a full color image. Simultaneously using the three primary colors allow LCD projectors to produce accurate color rendition.

To improve upon the limited contrast ratio capabilities of the LCD system, Texas Instruments developed the DLP (digital light processing) system. Rather than filtering out light, the DLP system instead uses mirrors to redirect light away from the lens of the projector. DLP chips consist of rows of mirrors each representing a pixel in the display. To produce color, DLP type projectors use a spinning color wheel to output one of the primary colors at a time. Although no two colors are visible at the same time, this process takes place so quickly that the human persistence of vision sees them simultaneously. It is important to note however that this can produce color inconsistencies when photographing or filming projected images.

There are many different specifications that define the capabilities of a projector. Below are some of the important distinctions:

Resolution refers to the number of pixels used to create an image. A pixel is the smallest measurable point in a video image and takes on the color and value of the one specific point in an image. In a projector, the resolution is measured in pixels width by height. For example an HD display has a resolution of 1920x1080 pixels.

Aspect ratio defines the relationship between the width and height of a projector. Modern widescreen formats are typically 16x9, while legacy standard def equipment is a squarer 4x3 ratio.

Brightness in projection is measured in lumens. This measurement refers to the total amount of light the projector is able to emit. This number can vary greatly depending on the light source of a projector. Many consumer models emit 5000 lumens or less, while brighter large venue projectors can range from 20,000 to 40,000 lumens.

Contrast ratio is a measurement that defines the difference between the brightest and darkest points in a projected image (full white and full black). This number can vary greatly between different types of displays, but the average DLP projector will be around 2,000:1. The contrast ratio is not only important in terms of image quality, but also it is important to understand video black. Projectors contain powerful light sources and are not able to fully block out all of that light with their DLP or LCD imaging devices. The contrast ratio will help define how close the projector will be able to produce a true black as opposed to a dark gray.

Once the projector creates an image, it will then exit through the lens to be sent to a screen. There are a variety of lens types for projectors. Some zoom, and some are fixed focus. Zoom lenses are useful for sizing an image to a screen without moving the projector, but should not be relied on as the sole method for choosing the size or a projected image. With basic algebra, the projected image size can be determined based off of the throw ratio of the lens. The ratio reads as a relationship of the distance between the screen and projector over the total screen width. Of the ratio, screen width and throw distance, if two are known, the third can be derived mathematically with R=T/W were R=lens ratio, T=throw distance between projector and screen, and W=the width of the screen.

DIGITAL LIGHTING

This classification of devices was born out of the lighting industry as a means to control image producing devices through traditional DMX control products. As early as 1999, early versions of digital lighting were being demo-ed at Lighting Dimensions International (LDI). This initial experiment, the Medusa Icon M attempted to take advantage of the new DLP technology to created a more flexible moving light with built in digital gobo libraries. Although the Icon M never made it to production, it paved the way for an array of new and exciting devices.

Currently there are two main manufacturers of digital lighting: Austin, TX based High End Systems and Czech Republic based Robe. Both companies offer a series of moving-head projectors with built in media servers. What sets these devices apart is that they are compact full service devices in one package. Unlike any other system, these moving head projectors cut out many of the other technological pitfalls associated with complex projection systems. Much like a traditional moving light, moving head projectors need only a simple DMX command to run multi-layer video effects directly to the built in video projector. Without leaving the lightboard, a skilled operator can pan/tilt and focus a projector around the venue and then seamlessly move to content programming. With all of the tremendous advantages also comes a few disadvantages. Moving head projectors typically lack the high lumen output desired by most shows, and also suffer from the harsh treatment usually associated with moving lights.

For example, High End's most recent version, the DLV packs a 4,000 lumen projector and an Axon media server into a relatively compact body. As a comparison, the most powerful unit in Robe's DigitalSpot goes as high as 7000 lumens, and the Barco developed DML-1200 will go as high as 12,000 lumens. For shows with more high-powered needs, there are a few alternatives. High End offers the ArenaView orbital head system which uses a moving mirror system to move the image of much larger venue projectors. For maximum flexibility, the Christie YK200 Dual Arm Yoke will support up to a 20,000 lumen projector and still provide precise motion control through DMX.

PROJECTION SURFACES

When planning a projection system, the surface being projected onto is equally as important as the projector being used. Projectors should be viewed as a light source, following all rules that other lighting devices follow. The most important rule to understand is that when the eye sees an image it is a beam of light bouncing off of an object into the eye. When the beam of light hits the object it modifies the beam of light depending on the surface. Color is produced by this method. When light hits a colored surface, colors not included on that surface will be filtered out. To understand how projection surfaces work, the engineer must understand that the properties of the screen will drastically effect how much of the light from the projection source will be reflected back off of the surface.

Gain is the mathematical representation of how much light is being reflected. A Lambertian gain of 1.0 represents all light being reflected back in a perfectly even distribution. From that basis factors such as reflectance, color, and texture will all lower the gain significantly. Off the shelf screen products account for these and other factors, but when projecting on a found space or constructed screen, these factors must be taken into consideration to ensure appropriate brightness. In other front projection applications, manufactured screen products have engineered their products to reduce the reflectance of off axis ambient light.

When rear projecting (RP) through a translucent surface, other factors apply. RP screens allow for not only a higher contrast ratio, but also increase the gain by focusing the light into a tighter angular dimension. When RP'ing onto standard fabrics such as muslin, light from the projector is scattered in all directions, many of which and audience would see. The lensing of the RP screen directs all of this otherwise wasted light towards the audience. While this is very advantageous, it can create other issues when edge blending multiple projectors. When placing projectors behind and RP screen, it is important that they all be placed in a central location, physically sitting as close to each other as possible. This eliminates the possibility that the angular cone of all projectors will not be hitting all of the audience simultaneously.

When placing the projector in relation to the screen, problems can naturally be eliminated by placing the projector in as straightforward a manner as possible. Most projectors are designed to live immediately above or below a screen. Placing a projector off center or out of line with the top or bottom of the screen will create not only keystoning and geometry problems, but also brightness problems. A law of the physics of light and color dictates that the angle at which light hits a surface will equal the angle at which it will reflect off of the surface. In terms of projections, if a projector were to front project from far screen right at a 60 degree angle, the majority of the light will bounce off of the screen surface at a 60 degree angle screen left, away from the audience. If the project is place dead center, perpendicular to the screen, the light will bounce directly back towards the audience.

LED SCREENS

In order to truly match the visual intensity of modern lighting effects, modern projectors just are not yet bright enough to do the job on their own. To truly match the luminance of a truss full of lighting equipment, LED screens must be used. Light Emitting Diodes (LEDs) are small solid-state light sources that emit a specific spectrum of light. Many modern lighting chips include either RGB (Red, blue, green) or RGBW wavelengths combined into one small package. These light sources come in many different shapes and sizes, but are small enough that a single LED can be used to replicate one pixel on a video screen. The most important difference between this and a projection system is that many LEDs can emit light directly towards the audience, whereas projectors typically rely on a single light source to bounce light off of a reflective surface towards the audience. This is why LED screens can achieve much high levels of brightness.

LED screens are much harder to define, as they come in many shapes and sizes. In their simplest form, LED screens consist of modular high resolution panels combined to create a large HD display. Other forms consist of lower resolution creative devices designed to allow for artistic non-rectangular video displays. In their smallest form there are low-resolution LED displays built into several moving head lighting devices.

The classifications for LED screens are much different than projection systems, so here are those specifications listed below.

Size: Since LED screens always come in modular form, it is important to look up available sizes for the device you are looking at. This will typically be measured in both inches and millimeters for accuracy.

Brightness: The total output of a panel is typically measure in Nits, the Si unit of Luminance. This measurement is related to the lumen measurement of projectors, with the distinction of measured light output over a given surface area. The G-lec phantom 7 for example emits 12,000 Nits per panel.

Resolution: This definition remain the same, but individual panels in this instance will provide much lower resolutions then other display sources, but can be joined to form a much larger high resolution device.

Pixel Pitch: This measurement defines the distance between individual RGB pixels in a video screen. This measurement is important, as event display devices will vary much more than consumer electronic equivalents. High-resolution screens will be single digit millimeters apart, while creative modules can be inches or more between pixels. When assessing this measurement it is important to take into account audience distance from the screen as well as a close-up video recording taking place.

Viewing angle: Like many consumer devices this measures how many degrees off center an audience be located and still view the image on screen properly.

Other questions to ask include: the following. Transparency: Can we see through the screen? If so, how much? Construction: how do they connect? Distribution/Control: How are individual panels connected?

LED screens can be low enough resolution that no clear image can be seen, this does not change the fact that they are still play back moving video content. Low-resolution screens are typically used for more creative means than playing back sharp clear imagery. Many times these devices are incorporated into scenery in a nontraditional way such as past tours of the musical croup Radiohead.

PIXEL MAPPING

As mentioned above, the use of low-resolution display devices can begin to truly merge lighting and video. What is important to understand is that an array of any number and type of lighting sources can form a group of pixels and therefore a video display. In the low-resolution LED screen examples, we see that this can come in the form of square LED panels or also linear strips of pixels. While these options provide flexibility, there is still even more room to be creative. Some modern media server software will allow the user to define individual pixels as any known lighting device, all the way from an incandescent light bulb, up to a High End Systems Showpix.

In these cases, it is vital to understand the function of individual pixels. In its simplest form, a series of incandescent light bulbs connected to dimmers can form black and white pixels. The light bulb scenario provides only intensity parameters for each pixel and thus provides the most basic abstracted form of video display. From there, the options can go up to include full color LED sources or even CMY mixing automated lighting fixtures. The core principle here is that a specific portion of a video is being played back on a media server and *mapped* to a specific parameter of a lighting device. This can be limited to intensity or color, but can also include more advanced functions such as movement.

From a lighting designer's perspective, mapping provides much more than a dynamic visual look, it provides a new unique form of control for many intelligent lighting instruments at once. As an example, a large arena show may have LED lights embedded into the stage deck and risers of a custom built stage. If the stage is sufficiently large, it could take hundreds of a small LED fixture to cover the entire stage with light. Older methods of programming could take an experienced programmer an unreasonable amount of time to program such a large number of lighting instruments. Through pixel mapping, a simple video wipe could be applied to the pixel-map to seamlessly fade out the lights across the entire stage. So what is a pixel map?

A pixel map is a virtual layout of all of the devices in your setup. Lighting consoles and media servers alike have various functions to allow the programmer to choose the make and model to be used as pixels and apply it to their setup. To create a map, these lighting fixtures are then place on a virtual canvas in relationship to each other. The relationship is dependent on both real world spatial arrangement as well as pixels. In essence, these maps are grids of pixels with specific definitions for what each pixel is. Because of this, they are inherently measure in pixel space. When working with a series of high and low resolution devices, the operator must also find a way to account for the real world relationship of these units. To explain, if an image were to travel across two 400x400 screens from left to right with a 10 foot gap between the two, the map for these screens would not be 800x400, it would be much wider to account for the 10ft gap. Using the pixel pitch of the screens, an appropriate approximation for the ten feet can be translated into a pixel count spacing on your map.

TRADITIONAL MONITORS AND DISPLAYS

In additional to large format displays, traditional video displays such as televisions and computer monitors can be used to display imagery. This can be used to represent certain styles but also has practical functionality as well. Antiquated tube TVs can be used for period effects on stage, and conversely modern high definition TVs can provide a very sleek and modern look. Modern LED computer monitors also have the added bonus of incredible brightness in a small space. Shows such as the Broadway production of *American Idiot* used these screens on top of projected imagery as an accent to the rest of the video.

Modern TVs and monitors have a much higher pixel density than large format projections. This could prove very useful for shows that will be photographed or recorded with extreme close ups. The disadvantage being that with such a high resolution over a small area, many more media server would be required if many screens are being used to cover a larger area.

PROJECTION SURFACE MAPPING

One of the most exciting uses of video projections in the last five years has been surface mapping, often used as exterior building mapping. Projection mapping is the use of video projection in conjunction with 3-dimensional surfaces to create a video display that transcends physical and virtual boundaries. In projection mapping, specific features of a building or other surface are recreated in a virtual world. Once the virtual version has been created, content can be created or modified to play back matching the specific spatial arrangement of the projection surface. What defines mapping is that a truly mapped video projection will not make coherent visual sense when played back on a flat monitor. In the example of building mapping, a line of lighting tracing a brick pattern may be captivating when mapped, but on a video screen it may look as simple as a small dashed line moving around the screen.

The process of video mapping involves a lot of precision in its execution. The fundament first step is that the content creator acquires an accurate drawing of the surface to be mapped. All animations an edits will take place based off of this drawing. If known, the project files for the content creation can be set to match the overall resolution of the projector/s to be used for the mapping project. On the flip side, the physical setup must be laid out in a clear way that places the cone of projection precisely on the area of a surface or building to be mapped. When the projectors and control system are operational, the programmer can then use a version of the design template as content for the projection system. In fully 3D environments the drawing of the surface will not immediately match the surface being projected on.

Projection mapping has made a name for itself in many public displays. Projecting onto buildings has become an art form all its own. Taking video out into the streets provides the production with a larger demographic and is therefore well suited in the world of marketing. Passerbys can walk by a familiar building and see a distorted reality design by the video artist. What is unique about projection mapping is that is takes advantage of the way humans see objects. In order to see any object the human eye sees light that has reflected off of a surface and taken on the color of that surface. When evenly lit, we will see objects exactly as they are. In the case of projection however, the artist can control what light is coming from an object. When ambient light is taken out of the equation, the projector defines what is, or as not seen as well as how we see it. The most effective mapping displays use the features of a physical shape to their advantage and match aspects of the video to shape. When combined, the effect is compounding; the inherent 3D aspects of the shape conform with the 3D aspects of the video.

Since various points on a 3D object will be different distances away from a projector lens, this will naturally distort the image being output. For example, an awning coming off a building will be closer to a projector hence creating a smaller throw distance and smaller image. Conversely, a recessed doorway may product the opposite effect. To compensate, the playback device must incorporate a system to compensate for these 3D distortion. High quality media server system will allow for various surface scaling, as well as skewing tools for surfaces at off axis angles.

In any mapping installation, found surfaces can often be limiting. The surface may have low reflectance and dim the projected image, the surrounding area could have high ambient light, or the space around the surface my not allow for adequate throw distance for a projector. In all of these cases it is important to understand the limitations of projectors and manage the production around these aspects that cannot be modified.

Chapter 10: Resources for Content Playback

SIGNAL TRANSMISSION

One of the many factors that adds complexity to video application for the stage is the signal transmission method. In large venues the media control area cannot always be in the ideal location. When this is the case, a detailed understanding will allow the system planner to get the video signal from the media server to the output device. Planning this signal cable must include factors such as rated transmission length, interference from other systems, and physical safety from moving scenery and performers.

Many different cable types are available for consideration. DVI, and HDMI are the two sources being driving by the consumer market. DVI has many different physical formats allowing for different features. While the size of the connector does not change the pinout has several different forms that must be recognized. HDMI while not having as robust of a locking connector, does have the added bonus of transmitting audio and video on the same cable. VGA cable has been around for computer display for many years but is still widely used. VGA cables allow for many different resolutions, but suffer from the limitations of analogue transmission. Over long lengths VGA signals will weaken and the image will degrade. HDSDI is a professional digital video format that allows for the transmission of a digitally compressed multiplexed signal over a single cable. Other analogue sources can be used, if care is taken to avoid long runs of cable that may degrade quality.

Extended Display Identification tools (EDID) allow for the control of output settings on servers without having the physical device present. A small EDID tool can plug into a computer or media server and tell the device that a video display is currently connected at a predefined resolution. This allows for preprogramming on a server before the display is set up or rented. Many servers and computers will not allow for the programming of virtual screens unless it detects that the device is currently connected. The Green Hippo DVI parrot for example allows for the device to be connected via USB and programmed to any desired screen setting and stand in for the screen to be used on stage.

SWITCHING

Video switchers are tools designed to control the flow of video signal between multiple input and output sources, much like an audio mixing console. A high quality video switcher can control and route for example many live video camera feeds for image magnification (IMAG). A quality switcher will allow for previews on inputs and outputs on separate monitors, allowing for the operator to make changes live on the fly with accuracy. While viewing all inputs, the operator will be able to choose imagery to be sent live to the output, and preview the next "on deck" video input that can be cross faded to at the desired time. The output can be processed and sent to video screens live, or to hard disk recording devices for the documentation of performances with multi-camera shoots.

Other video switchers like the Barco ImagePro act as a video Swiss Army knife. Simple rack mount units like these allow for quick routing, scaling, and sending of content. Having a tool like this on any system allows for problems with incorrect resolutions or signal format to be resolved quickly without additional drain on the video output source processors.

Hardware media server examples

Dataton's Watchout is a networked server solution that functions as a timeline based system. This system is popular in theater and opera for its affordability and ease of programming. Although it is simple in some ways, it is robust in others. Watchout is what can be defined as screen management system. Unlike many other solutions, Watchout does not allow for complex content modifications. Instead Watchout focuses on managing and merging many video input and output sources cleanly. This aspect is especially appealing to video professionals in the corporate event field. Watchout allows for seamless addition of live video feed control from SDI video sources such as cameras, as well as networked content from a presenters laptop computer.

Pandora's Box is one of the most full featured of the systems listed here. Produced by the German company Coolux, Pandora's box offers a highly scalable system ranging from software only, to multi-output hardware with networked interface devices. Modeled after the animation software Adobe Aftereffects, this system not only has advanced 3D warping capabilities for its outputs, but also in depth content modification and creation tools.

Green Hippo, popular in the world of music is a powerful server frequently integrated into the lighting system. This system features complex pixel mapping for lighting fixtures built into its software and easy to set up DMX control. Servers such as Axon, Maxedia, Mbox, Arkaos, MA VPU are all classified together as products of lighting manufacturers. While all having their differences, they all function in a similar manner. Ai Server with Sapphire media control is a recently released product as of late 2012, this system has a unique hardware interface unlike many other systems that is based off of traditional video switching devices while retaining ergonomics of a lighting console.

SOFTWARE MEDIA SERVER EXAMPLES

For the relatively less robust playback needs, many solutions exist utilizing off-the-shelf computer hardware. Many of these programs have been crafted over the years to meet the demands of solo video artists and other experimenters in the field. For example Isadora was developed specifically for the Troika Ranch dance company by collaborator Mark Coniglio.

Isadora has long been a standard for theater and dance. This piece of software is incredibly flexible. It allows the programmer to create his or her own playback environment through a visual coding method. Unlike other cue based or timeline based playback system, Isadora breaks its programming down into several interactive scenes within which many looks and cues could be programmed. The program includes many different built in effects and modifiers for video content while also allowing for the download of additional tools online. While this program is versatile, it can be cumbersome and slow to program certain simple effects.

Modul8 is the gold standard for VJ playback. This loop-based system allows the user to create an A/B setup in which the show is created one look at a time on the fly and then crossfaded to a live mode. Unlike many playback solutions, modul8 relies heavily on its graphical user interface (GUI) for fast operation. Frequently used in the music industry, the software allows the video artist to keep up with the pace or their collaborating musicians.

INPUT SOURCES

In order to maintain the liveness of a proper stage performance, integrated media must maintain a certain element of interactivity. This can come in many forms, but regardless of the way it is presented, it requires some sort of input from the environment around or connected to the performance. Image magnification (IMAG) video displays are a method that uses live video feeds to share alternate views on a performance or its surroundings with the audience through large format displays. Using a series of video cameras and switching devices is outside the scope of this writing. A series of cameramen and video producers are able to combine feeds from multiple sources into one live display cut cleanly to the performance. Often times, these feeds can provide close-ups or details of a performer to a larger audience in a meeting or festival environment. Especially as is the case with high profile performers, it can be difficult or expensive to sit near the stage. To accommodate the cheap seats, the only two options are to provide binoculars for every seat, or provide a display system that will allow them to be as much as part of the performance as floor levels seats may be in certain arena shows.

While IMAG may provide vital functions to largely attended shows, the scale of these shows provide other inherent complications. Two important rules apply to these productions. Light travels faster than sound, and every node added to a video system will add at least a frame of delay. When trying to synchronize a close up of a performer with the P.A. system, these will both be huge factors. To account for large distances between performers and audience members, distant speakers are often set to delay output to account for the distance traveled from the stage amplification. This process must be factored in when synchronizing live video feeds of performers mouths to their speech.

Virtual Network Control (VNC) allows for screen sharing over local area networks. Through this system, and computer with appropriate software can share screen captures or virtual controls over a basic Ethernet connection. VNC is a function supported readily by both MAC and PC. This handy tool can be used not only to manage media servers in a system, but also for the sharing of content live from computers. This can be network and processor intensive, but is still and clean and simple method for providing live slideshow presentations from corporate speakers with little hassle. This system relies heavily on compression, and therefore is more suited to Powerpoints which can contain large solid backgrounds, or little change from frame to frame. Playing back video over this system requires more system resources for decompression, thus creating a less than ideal situation.

As covered in show control there are various methods for video systems to interact with other show control systems for live performance. In order for the show to be interactive, it is importance to have performer-media interactivity. While the live control of a slideshow is technically interactive, other more involved systems exist. Mainstream video game controllers such as the Xbox Kinect with NiMate allow for full skeletal tracking in three dimensions, and data sharing. Other proprietary systems such as the spatial scanner provided as part of the Pandoras Box system will allow simpler 3D motion tracking over larger distances with greater consistency. This system can be used for effects such as pre-recorded mega-church shows relying on movement of clerics to determine call times for cues rather than a traditional stage manager.

NETWORKING AND CONTROL SYSTEMS

Show control is defined as the connections of separate entertainment control systems. In large industrials or concert events these systems can contain many elements. Video being just as integrated into the show as any other lighting or automation system, can often times need to be physically connected to those systems. For staged video solutions to reach their full potential, they must be able to match the motion of the lighting and scenery on stage. In explanation, modern automation technology allows for custom projection screens to track across stage via motorized systems with absolute precision. In that case, show control can be used to tell the media server where the screen is in three-dimensional space and move the video content accordingly. Many other systems can be linked to video including but not limited to: lighting, sound, automation, interactive elements, musical instruments, effect/pyro and lasers.

Show control can take many forms, as many different industries all have their own standards. Media sever and show control systems can often speak many of these control languages, but it is important to understand what each of them do and how they can help drive the video content in the show. Once the standards are understood, the correct choice and type of control can be determined. There are methods of direct control, as well as means of syncing the systems together over time via various forms of synchronized time code.

LIGHTING DEVICES AS PLAYBACK

As mentioned in the pixel mapping section, lighting can be a big part of many video applications. The lighting and video system can be completely separate systems, or they can be one in the same. It is important to understand the basics of lighting systems to understand how they fit into a video system.

Lighting consoles have developed over the years as arguably the most polished form of stage control and programming. They allow for quick control over many looks and settings in a very ergonomic and functional way because of this many of these consoles are used to control media servers, or in some cases, include built in media servers. When pixel mapping and video displays are combined, the light board can be the most effect way to sync these systems together. While there are many ways to manage this, the programmers must realize that media servers are built for ease of programming, while lightboards are often built for easy of show playback.

SIGNIFICANCE OF PLAYBACK AND CONTROL

All of these complex tools can seem over complex for the simplest of video installations, but they exist for a reason. Designers are always trying to be on the cutting edge, and this often leads to ever more complex and discontinuous screen surfaces. Traditional playback sources such as DVD players only allow for video playback to a single screen in a completely linear way. As video designs expands to become a living part of the scenery the tools must be utilized to allow for the management of screen imagery over many spaces within a complex timeline of events.

The difference between traditional playback methods and media centric performances is that video becomes malleable element within the performance. Much like props, and performers, the video must be able to adapt to the performance around it, this means live management of content and timing as well as 3D manipulations of content in the real physical space of the stage.

Chapter 11: Human Resources in Video Centric Performance

BREAKDOWN OF SKILLS

Specializing in design and implementation in video for the stage requires a very specific study of industry practices. Many video designers are crossovers from other areas. Since video allows for such free visual representation, it attracts many different entertainment professionals. Scenographers see it as a way to show images that extend beyond the scope of stage realities. Their designs can so rooted in physical realities that they use the screen as an extension of real elements on stage, or worse as a cheap replacement for designs which could not be implemented. Lighting designers see video for the stage as a new and exciting way to control light color and detailed texture on stage. Film/video producers can see video centric performances as a new way to express their art, but may lack the 3D spatial understanding or the flexibility that live performances require.

As video for performance expands, so do the skills required. Currently education institutions separate video skills into many different departments. Film schools teach film, theater programs teach live expression, art departments teach visual representation. These training programs include video but in the context of the larger education program.

Regardless of education, video professionals can come from a multitude of backgrounds, and it is important for a team to be assembled that complements each other's skill sets. A content creator for a show can design great content, but if the playback of that content falls to a master electrician or other unqualified personnel, the content creator may not have the skills to understand why the content on stage does not match the visuals on his computer screen. In early production meetings, clear roles must be defined to be sure that the video portion of the project is followed through from start to finish.

With proper understanding of the skills and relationships that a large scale video centric performance requires, many different artisans and technicians can come together to produced a combined art form that integrated visuals in new and exciting ways. The following is a detailed account of the many contributors to such a performance. This is a list for the most demanding projects, often times these roles can overlap or multiple roles can be handled by a single professional.

Creative director/projection designer: In a performance where video is the primary focal point, the creative director handles the overall scenography and design of the installation experience. In other types of performance the projection designer handles the visual design and how it fits into the context of the performers on stage.

Space/Scenic designer: This person can be the scenic designer, or someone with a background in architecture. The space designer may also perform duties of environment design, or even design scenes for filmed content.

Graphic designer/2d artist: This person ideally comes with a background in the visual arts. With his/her skills in creating a cohesive piece of art from scratch, the designer's ideas can be brought to a realized visual form.

3D artist: From the 2D artist's work, a 3D artist can work to either build directly off of their work, or use storyboard art to create a fully comprehensive piece of 3D content.

Motion artist: The motion artist takes visual art or 3D shapes/character that have been realized in full detail and transforms them over time. This artist handles movements and effects with animation software such as Aftereffects or Cinema4D.

Video specialist: Handles all recorded video production. This person would have a background as cinematographer, or even director of traditional film projects. The video specialist would be able to create content based off of real life performers or physical object that are not practical to create digitally. This may include filming real events or places for transformation into the digital space.

Postproduction: Handles the NLE editing tasks. This may include editing filmed content, or cutting together a variety of digitally produced content. The NLE editor should be able to composite multiple video sources together into a cohesive visual picture.

Media server programmer: The programmer takes the prepared content and loads it into the playback system. This process includes the distribution of content to all display devices and synchronizing that content over time throughout the cueing process. A good server programmer will be able to handle formatting problems with content and understand the networking of multiple systems and display devices.

Interactivity designer: Deals with the interaction between performers and video content. This could means designing physical interaction methods, or planning content to fit audience input. Interaction includes not only physical interaction with the audience but also virtual interaction over the Internet and other digital contributions.

Lighting designer: Handles pixels mapping, lighting device selection and balance of levels between lighting form video displays and lighting in the performance space.

Master electrician: Responsible for power and cabling needs, this may or may not include system and show control networking.

Integration specialist: On site manager, handles the transition between the digital space and the stage space. This person can run the cueing process. It is a complex process synching lighting video and other systems on site, and requires a dedicated team member to lead the team to their unified goal.

Content manager: Makes sure all footage is segmented and formatted appropriately and provided to the right personnel at the right time.

TD/site specialist: The technical director handles the planning and implementation of the physical elements in the show. In regards to video this includes rigging, safety and on-site concerns. The TD can coordinate projects in offstage locations including planning power sources, anticipating weather problems, and scheduling load-ins with house personnel.

System operator: If the show is not a canned performance run on a timer, a dedicated operator may be on site for each performance taking cues at predefined times in the performance.

TIME MANAGEMENT AND LABOR PLANNING

When working on a media centric performance there are certain factors that need to be considered when planning or scheduling the production. In any long-term project, progress points will help determine on time delivery of the final product, and also provide feedback as to how the project is progressing. With video, these progress points also act as safeguards. Structured deadlines in advanced of a performance allow the video team to protect themselves form the hazards of the field. When many designers, animators and technicians are working on a production, compatibility issues can arise. Different computer hardware, software, version number, and file format can all cripple the collaboration process. Allowing team members to share files in a structured deadline system accounts for potential technical holdups. Unless all content is created and played back on a single system, this is a scheduling factor that cannot be overlooked. Other determining factors for deadline creation, include time and number of revisions to be expected, as well as rendering and output of high level 3D content. Rendering is a part of the process that can be unpredictable, slow, and generally frustrating. Much money can be spent to upgrade computing power, rent render farms, or update systems, but nonetheless rendering high definition video takes time. Time which must in turn be factored into an schedule. The video content is never done until its loaded and running on the media server.

In any show there is a point of no return. Eventually, there will be no time for content to be re-rendered, filmed, or otherwise adjusted. In these cases it is important to know what can be adjusted and what cannot. I any situation with detailed custom content, it is safe to say the content will not change. The media in question can but cut, or replaced by filler, but on deadline high-level content does not allow for on the fly editing in its native application. What I mean by this is the video file will not change, but there are various possibilities in how the video file is played back. A powerful media server will allow for these live alterations, but are no substitute for real content changes. The programmer of the media server will be the best person to determine the extent of these changes, but basic changes include speed changes, chroma-keying, color shifts, and crops. Every media sever is different, but reading the most up to date literature on the system is the only way to determine the extent of its capabilities. Regardless, these questions must be asked, and in far enough advance to allow for appropriate wiggle room in all content.

SITE SURVEY AND PLANNING

When planning the installation of a projector or other video setup, there are many factors to consider. The most straightforward one is the power requirement. Larger format projectors and LED screens usually have larger power requirements than other items on stage. Owed in large part to the amount of light required of these devices, the power input can vary. Larger sources, not only require extensive amperage, but also higher voltages. Power distribution can be a complex task, requiring a certified electrician, and often contact with the house manager for power availability. The safest way to deal with these requirements is to memorize the specifications of the equipment to be used and deal only with qualified personnel when planning power distribution for a venue.

As is the case specifically in the world of projectors, a properly rigged device will alleviate many problems down the line. While a projector follows the physics of light transmission, that does not necessarily mean a projector should hit the screen surface at any angle that is convenient. The manual for the projector model should be consulted to identify the rigging limitations, as well as the desired lens to screen configuration as specified by the manufacturer. What may be appropriate rigging/mounting in the lighting industry may not work well in the realm of projections. A well-mounted projector requires stability to prevent shaking and movement of the image on screen. The mounting system should allow for proper ventilations, and in some cases additional cooling may be required when large venue projectors are confined to tight enclosed spaces. Access to the menu functions necessitate access to the menu panel, or ideally a clear line of site to the RF terminal for the remote control. To make things smooth this remote control access should allow the user to get a clear view of the screen while operating the remote. This means having access to either the front or back remote terminal depending on the realities of the production. The setup of the projector should also allow for work access to set up the most precise possible alignment. Mounting systems should allow for pan, tilt, and yaw, while still locking tightly in place when adjusted.

When site planning for a media centric performance, the mounting plan must account for the throw distance and angle imitations of the gear. This may mean determining what lens may be required for the venue, or how extreme of an angle is allowable given certain circumstances. As adjustments need to be made, heavy burdens to the labor requirements to rig the unit, and adjust for distortion in the tech process will be added. Planning a load in/out of a media setup, should include not only technical staff but also any specialty rigging, power staff needed to feed the infrastructure of the video system. As things are sorted out with the site or venue of performance, the schedule of the performance must include specific time for video production. There is no such thing as enough time to cue a show, but video must be allowed to claim it's own fair share.

Chapter 12: Working Documents

The pitch is the most important element to define a media centric performance. If the pitch for any show does not include the use of media, then the media design is simply a means to communicate scenographic information. A written pitch should sum up in two or three sentences the plot of the action of the show and how media can help drive that forward.

Script/Storyboard, Content Summary, and sage design rendering should all be included as discussed in previous chapters.

Equipment lists/Shop orders are a simple yet vital pieces of the puzzle. The list creates a concise view of all gear to be used. Having a concise view consolidates work on budgets and specification of new equipment. This list can include other helpful details such as cost, dates required, and where the gear is to be sourced from.

A system diagram for a video system should include every node in a system and a clear communication of how they are connected. The connections include cable type as well as connector type. Complete system diagrams include every piece that is required for the system to function including any adapters or peripherals form workstations. A clear system diagram uses a graphic format to quickly communicate what nodes connect in what order in the system. Clear use of color-coding can identify things like separate cable types and distinguish other small differences that might otherwise go unnoticed. When the video system is connects to other show control, those would also be included. Anything that is in some way connected to the video system, power included, must be drawn.

Resolution diagrams are documents that help relate the pixel space to real world dimensional measurements. The diagram overlays the resolution and aspect ratio of the projector over the projection surface to be used. In cases where the full screen is to be used this may be superfluous. Resolution diagrams are most useful to setups that require content to be fit to nontraditional sized screens. Having this diagram allows for content to be created to fit the scale and aspect ratio of its intended final output method.

The CAD for a video installation can range in complexity, but should always be based on absolute precision. Starting with a groundplan, the basics can be determined and drawn in an efficient manner. Groundplans will help determine viewing angle, projector throw distance, and proper lens configuration for a projector. Additionally, the groudnplan can indicate locations of the space used the video department. In corporate staging, a large area may need to be set aside for a video village. The groundplan will help communicate where the video team intends to work, including rigging, cable runs, and programming locations. The CAD may also include a section of the venue to evaluate angle at which a projector shooting. These angles not only determine height, but amount of keystone and obstructions from performers. Using the section, the planner can determine safe walking areas for on stage talent that will not cause shadows on the screen surface. Once the locations and distances are worked out, the show my often require a mounting diagram for the projector demonstrating how and where the projector fits into truss or around other equipment backstage. The core value of the CAD work is to determine clear measurements from which gear will be placed later on by a setup crew.

In preparation for the integration process, the media may be finalized, and a timeline in hand, but the job is not done. A cue list is separate from the timeline and includes the separation media files that are to be used. Where as a storyboard is the visual image seen from start to finish, a cue list indicates only points at which a cue on stage must be called. This called cue could be a simple photo projection on cue with an actor's line, or it could be a new piece of video that fades in with the volume of an opera singer's vocal decibel level. Without a cue list, the content creator may output the whole show as one file, or as many unmanageable small files that require the extra creations of cues in the media server and extra links programming them together.

Chapter 13: On-site Integration

TROUBLESHOOTING

The best way to start any troubleshooting for a gig is prevention. If things can go wrong, I can assure you they will. Prevention includes safe transport of all hardware using proper cases and packing materials only. Care should always be taken to upgrade the system with any pertinent manufacturer updates and keep the entire system in sync in the most matching formats possible.

No amount of care can prevent a hardware failure. The question then becomes how does the show go on with a failed hard-drive? Of course, the show may go on, but if the on site tech is prepared, the damaged gear should have standard consumable parts on hand for quick repairs.

RUNNING A SHOW, PLAYBACK AND SAFETY

After a show is ready to perform for a general audience, what then is required for the running of the show? Themed entertainment and 4D cinema may be able to rely on in-the-can content, but many system require complex interactive environments or experienced technicians to run this video content live with a show. The playback system should be planned well in advance of the integration period, as this does have an influence on some of the earlier factors. A skilled live operator provides the most flexibility, and also allows for human intuition to reason what the best course of action is if the show takes a turn off book. While nothing currently available could replace the human mind, interactive elements help merge the video content with the stage performer. This can be a refined system, but in addition to playback, live system control must include certain fail-safes. Video technology may not have some of the dangers of automation systems, but it often works in tandem with these hazardous systems. If things were to go wrong on stage, how would they be solved? Would a feedback loop cause sound controlled laser to blind an audience, or and LED screen to playback unwanted content? If these factors were not considered it can be embarrassing. Not only embarrassing in fact, but also in some cases dangerous. In a dark theater a sudden burst of light from an idle projector could disorient an unsuspecting rigger, causing a fall or worse. Control must always include fail-safes and override stoppage in all stage environments.

DOCUMENTING FINAL RESULTS

Once the show is staged and running in front of a live audience, the last step is to enjoy and document the production. Enjoying the show may be as simple as grabbing a ticket at the box office, but capturing archival images can have its own considerations. I recommend any video professional to organize a photo call in which lighting and performers are staged to create an accurate representation of how the show appears to a live audience. This photo call may involve actors taking still poses, or the lighting designer taking down the master levels of all lighting down to allow for more balanced photographs. If this is not possible, RAW and HDR photo capture allows for highlight and lowlights to be adjusted more thoroughly in post-processing. Photographs do not capture the dynamic range of the human eye, so photo editing the values of the captured image is required for accurate image representation.

Video recordings of video sources, has their own nuances. Video capture frame rates must be set to match the refresh rate of the screen images. In most cases this with be a frame rate of either 50 or 60 frames per second. When using DLP projectors, the camera will also need to be synchronized with the color wheel of the imaging device. Many cameras sense this banding automatically and can adjust to eliminate it with onboard processing. In order for this to work, the same factors of white balancing a camera apply. The projection or video device must be well exposed and fill the entire screen to allow the on board computer to get an accurate representation of what it is correcting. Once corrected, video can be captured normally, all the while making sure to check color balance settings for accurate color reproduction.

Appendix A: In Between Script

In Between: A Journey of Cultural Integration

Brockett Exterior (The Installation Entrance):
The audience will enter the installation through the backdoor of the Brockett. In the hallway, there will be a sign-up sheet for scheduling appointments to see the production (must be written in pencil for cancellations) since only one person is allowed at a time for the show. Above the door is a large clock as the individual audience members will enter only during their scheduled time slots.

Entrance:
Upon the entrance, we will be in a narrow pathway which is created by black curtains. Dim lighting will light up the pathway and quiet music will play. At the end of this pathway there will be a door which leads to the room. On the door, we will see the title of the installation written in beautiful handwriting.

The room:
There will be a large desk in the middle of the room. On the desk, we will see a large book with blank pages. By the book, there will be a small desk lamp and a mug cup with pens and pencils in it. The drawers of the desk will be filled with school supplies. There will be a big window on the right wall and a hidden door on the wall in front of the desk. This hidden door will look like a continuation of the wall and the audience will not notice this door until at the end of the show when a door image will be projected on it. A simple standing lamp will be in the corner of the room and a few empty picture frames, and wall shelves will be on the wall. Everything in this room will be in different shades of gray. The wall will be subtly textured and painted to look distressed.

Scene 1 [introduction]:
A projected beam of light will fade up around the prop lamp and a girl's silhouette will appear on the left wall of the room creating the appearance of a girl sitting at the desk. The blank pages of the book will glow and handwritten English texts will start appearing with sound effects as if someone invisible is writing it. While the texts appear on the

diary page, we will hear a girl narrating the texts in Korean language. This will prompt the audience member to sit at the desk.

[Diary Entry] ** Note: The grammar in diary entries are intentionally written in an awkward way.

Dear diary...
It was another boring day at school. I am really getting sick of sitting at my desk all day learning things that does not interest me. I want to do some creative things! I want to draw, I want to be involved in plays, and I want to go see more exhibits and shows! But I do not have time for any of that... I have to study for the midterm exam that is coming up next month. I have to memorize stupid dates and names. I know that what I learn in school matters because I have to take college entrance exam but after the exam, how is it gonna help me get closer to my dream?
School was stupid as always, but at least I got to hang out with my friends after school. Today was Yoojung's birthday (pictures of girls in school uniforms, the birthday cake, and gifts start appearing on the empty frames) so we got a birthday cake for her. I always have such good time with my friends. When we talk and laugh, time just flies by! When I got home, my parents were waiting for me at the dinner table (pictures of a cozy house, family, and food appear on the frames) and with my favorite dish. Ah, I feel so happy to be around my friends and family :) I hope I get to enjoy this happiness as long as possible even after I go to college.

**Note: All the pictures will be cleverly cropped so that no faces will be revealed.

Transition to Scene 2: When the diary entry ends, multiple pages will flip (via projection) in order to give the hint that many days have passed. While the pages flips, the pictures on the frames will change rapidly as well.

Scene 2 [cityscape]:
Now on the new page of the diary, text will start appearing again.

[Diary Entry]

Dear diary...
I have decided. I am going to see what is out there. I do not want to do meaningless learning at school anymore. I don't want to be passive about my life. I am going to take actions. I am going to go out to the bigger world! Thinking about new place makes me nervous AND excited at the same time! Meeting new people, going to a different environment and being on my own is all just exciting!

The girl's silhouette will turn her head towards the window and projected imagery will begin to appear in the window. In the window, we will see a beautiful cityscape (not so detailed but somewhat abstract, bright and colorful) far away on the horizon line of the ocean.

Scene 3 [sailing]:
Silhouette will turns off the lamp and room will be dark. Then, we will see the bow of the boat cutting through the water. The room will become bright as the sky will form around the room (via projection). The fast moving water will be seen at the sides of the room and the distant city will be seen in the front. Over time the sky will grow dark and the bright gleaming city will become dim and gray as the traveler will approach closer to the cityscape. Things will grow increasingly gray and foreboding. As the environment will begin to appear a bit menacing, the lamp will snap back on shining light on the diary.

[Diary Entry]

Dear diary...
It was a long trip getting here. I am exhausted... and I am scared. This place is very different from what i expected. I was really excited about the new place and thought this place would be glamourous. I guess I had too high of expectation. This place is not like how I expected. What have I done? Was I sure about leaving home? How am I going to live in this new place? I already miss what I have left back home. It really sucks to say bye to my friends and family and leave my precious memories behind. But I am sure time will fly... or at least I hope it does.

Scene 4 [mountain]:
The distant city seen earlier will manifest itself as mountains growing around the room. From the ground, the mountains will shoot out of the ground around desk. Eventually, human-like figures with glowing eyes will begin to show themselves around the room. The number of these strange figures will steadily increase. The number of the figures will become overwhelming and they will start talking louder and louder in an incomprehensible language. Their eyes are fixed on the middle of the room where the audience member will be sitting. The text will start appearing again on the diary.

[Diary Entry]

Dear diary...

There are just so many things going through my head and these thoughts are pulling me deeper and deeper inside a pit. Why do they stare at me? Do I smell? Do I sound funny? I can't even understand what they are saying. Are they talking about me? Are they making fun of me? Are they going to hurt me? Oh.. What have I done? Why am I here? Did I make the right choice to come to a new place? I no longer remember my purpose of leaving home and venturing out to come here. What was it that i was looking for? What was my purpose? I am scared and confused. Everything is so unfamiliar.

Scene 5 [hiding]:

The figures will start to fade away at a predetermined point in the diary text. The bodies will fade until only the eyes will be seen. The eyes will grow larger as they fade out until only one will remain. As the final eye will continue to grow, an image of a room will be seen in the pupil. This room image will grow to envelop the entire room. The projection will wash out the grungy texture of the wall and paint the pastel tone wallpaper on the wall. Comfort and girly items such as blankets, dolls, and mementos will be projected around the room.

[Diary Entry]

Dear diary...

No one understands my loneliness and desperate need of someone; someone that I can talk to, someone that I can laugh with, someone that I can tell my feelings... just someone who would keep me company. I can't stop thinking about my home, my family, and my friends. I miss my room. I want to be there now.....I feel like I am alone against the world. I have cried so long and I am exhausted. But I know I have to go through this. I have already made a choice and I can't go back anymore because I have lost my boat. I am going to gather things to make this place cozy and comfy. I am going to build my own room in this place. I am going to start something on my own.

Scene 6 [Embracing]

We will see the mountains again. This time one of the mountain dwellers will come over and spark a fire. As it grows bigger and brighter, we will start to see a bit of a world in this foreign environment. and slowly dies out. As the fire will die out, the rising sun will be seen.

Scene 7 [seeking]:

The sun will begin to reveal the beauty of the place and the creepy shadows from the night will reveal themselves as harmless objects. The beautiful scenery will continue until a door will be seen on the horizon.

[Diary Entry]

Dear diary...
I am still lonely and scared but I am slowly gaining the courage to have the courage to explore this place now. It is not going to be easy and I know that. But I can't give up now because I don't want to worry my friends and family. I need to show them that I am doing well here.

I have to set aside my feelings of loneliness, anger, and fear. I am going to become a stronger person and push through. Eventually, all my emotions will go away and I will find myself enjoying this new place. I am sure that will happen...

Wake up and see what's out there! There is nothing to be afraid of! Be positive and build confidence! It's only the beginning of a new chapter!

The projected door will eventually land dead center in front of the audience revealing the real life door. The room will go dark except for the door.The audience member will exit.

Backroom: [Feedback]:
The audience will leave the room and find a diary on a desk. The audience will write their own ending to the story base on their own experiences.

Notes:
Total time per showing: 10 mins
Max: 1 audience member per showing
Entrance of audience on timer

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