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**A NEW PROSCENIUM: Exploring Interactive
Live Performance in a Socially Distant Digital World**

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**A NEW PROSCENIUM: Exploring Interactive
Live Performance in a Socially Distant Digital World**

by

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Abstract

A NEW PROSCENIUM: Exploring Interactive Live Performance in a Socially Distant Digital World

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The University of Texas at Austin, 2021

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In the era of virtual entertainment and social distancing protocols, many live entertainment industries are asking how they might create engaging experiences that connect audiences and performers. Is it possible to merge Theatre, Television, and Gaming into a new medium that plays to the strengths of each of these forms? What actions can be taken to successfully combine mediums and maintain liveness? How can we remotely and virtually connect audiences and performers?

In a connected world, with entertainment at our fingertips, my curiosity in cross medium entertainment has been given an opportunity, as a result of the global COVID-19 pandemic, to devise and create a system that would allow for audiences and performers to connect in real-time from anywhere in the world. While the prevalence of producing streamed theatre over Zoom places a temporary band-aid on the problem of being unable to congregate in person; Existing technologies allow for connections to be found for audiences and performers alike in live entertainment, using low latency video streaming,

audience voting, bespoke website user interfaces, and audience dictated diverting storylines; audiences and performers can indeed connect via a new spin on live entertainment. While there are inevitably obstacles encountered with emerging technologies and techniques, I conclude the live entertainment industry should explore the convergence of mediums rather than settle for the limitations of virtual Zoom Theatre or recorded Theatre performances.

Through a new residency presented by Texas Performing Arts and Fusebox in December of 2020, my collaborators and I, the Frank Wo/Men Collective, explored and designed a new medium that brought together features of theatre, film, television, and gaming. The resulting production revealed that the combination of mediums can in fact create engaging experiences that open up a wild variety of engaging opportunities for the audience and the performers alike. While the COVID-19 pandemic will eventually end, there will be a long-lasting effect on the live entertainment industry as some people may choose to avoid congregating with large groups for years to come. The solutions and explorations presented serve as a starting point for others interested in this live entertainment medium.

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I. Introduction

I have often dreamed of what the future of live entertainment will look like. Virtual interactive theater performances have been explored for a few decades, but only recently, as a result of the global COVID-19 pandemic, has the need for compelling interactive digital experiences been widely accepted by the greater live entertainment industry. The restrictions imposed on safe congregation and interaction of performers and audience have pushed all live entertainment to question what makes the experience of live performance truly unique.

The shared, embodied energy of the performer/audience relationship is lost in many attempts at streaming live performances on the internet. Streaming theater often increases awareness of the “fourth wall”, alienating the viewer from other audience members and disconnecting the performers from the audience, instead of dissolving the separation between the viewer and performer. Matthew Causey explores this in his words:

“Although I can easily discount the ontology of performance as being “in the now”, present and live, I hesitate at the lack of flesh in virtual performance.... The promise of interactivity in virtual environments is the breakdown of the isolation of the viewer and the actor that can define the theatre.... Like the classic question in science fiction, am I real or am I a simulation, the issue turns from witnessing the other to being the other. What is theatre in such a field.?” (qtd. in Dixon 486)

As the COVID-19 era entertainment responds to a new socially distanced reality, multiple mediums are now exploring cross-pollination between entertainment platforms previously considered separate. The obstacles of a live virtual performance experience

should be looked at as an opportunity to explore a new medium versus forcing Theatre into a mold that it doesn't fit.

Over the course of a year, I worked to develop, design & build components of a system to address the need for audience and performer interaction via an original website with my collaborator Michael Bruner. We were given the opportunity to implement this system through a residency at Texas Performing Arts and a new partnership with the international Theatre festival: Fusebox. Within the residency, a company I helped co-found, The Frank Wo/Men Collective, explored technology-based solutions to pandemic-era live entertainment by giving the audience agency to interact with the performer. In this game-like, live television and theatrical experience, the audience becomes an active participant as opposed to a passive viewer.

In this paper, I offer potential solutions for audience interaction, through the lens of a production for which I served as the Technical Director, Scenic, Lighting, and Graphic designer. My explorations and curiosities within this topic have been at the core of my work for years, and through this residency, my company, The Frank Wo/Men Collective was given the opportunity to explore the implementation of these concepts and ideas.

A. ENTERTAINMENT IN A PANDEMIC WORLD

Before describing potential solutions and problems discovered while involved in the Fusebox/TPA residency, I believe it is important to denote how multiple entertainment mediums have responded to the COVID-19-era and how their connections

to their users or viewers might aid in a more immersive and interactive live entertainment experience.

1. Gaming

Webster's dictionary defines gaming as: "the practice or activity of playing games for stakes." (*Merriam-Webster.com*) While this definition seems to be more closely aligned with gambling or sporting events, it is still of particular interest because it defines "stakes" as central to the activity. Including stakes for both the audience and performer are important in creating immersion and excitement while ensuring that both parties are invested in the outcome of the narrative.

When the COVID-19 pandemic forced the country into quarantine the gaming industry saw a large surge in computer and gaming purchases. Individuals were in search of easily accessible entertainment while quarantined at home. Personal computers, tablets, and all things computer related catapulted into high demand. Virtual and augmented reality goggles were in short supply. While some technology shortages can be attributed to a slowdown in manufacturing during the pandemic, I believe that this rush to purchase technology signals a shift into a new digital era of home entertainment. At-home gaming has seen a huge surge over the past few years and will only continue to increase in popularity as technology becomes cheaper and more accessible. Tapping into this large market will prove essential for live entertainment practitioners.

Online gaming on a PC and connected to a console can prove an exciting and immersive experience, especially when you play with people you know outside of the

digital world. In the game *Call of Duty Warzone*, teams of players are tasked with eliminating the enemy along with twenty-five other squads across a large open world environment. Experiences like these are heightened by the use of a headset and microphone, providing the ability to communicate with your team. The capacity to communicate and strategize heightens the shared experience, because the stakes of winning and losing seem so much higher when trying to keep your friends alive. These free-to-play Battle Royale style games, like: *Fortnite*, *Call of Duty*, *Pub G*, and *Apex Legends* have exploded into popular culture. The ability to communicate with others heightens the experience of game play and could prove to excite audiences and add a new layer onto live digital entertainment.

Recently the game, *Among Us* has shot into popular play. *Among Us* operates as a “mafia” style of gaming where individuals are anonymously made the killers. The players communicate with one another via a rudimentary chat to identify the killer before the entire team is assassinated. Players attempt to identify the assassin and vote to eliminate them? Any player could be the killer or entirely innocent. These games are fun and exciting because of the communication and team problem-solving that occurs while the game plays out. Utilizing text-based chat and voting could be used to enhance a live entertainment production.

2. Television

Television has cross pollinated cultures across the planet and heavily influenced globalist culture. Utilizing this medium for live performance could be a key for

connecting and engaging new audiences. Media Theorist Marshall McLuhan recognized the potential power of television and new digital mediums as early as the 1960's.

“As electric media proliferate, whole societies at a time become discarnate, detached from mere bodily or physical “reality” and relieved of any allegiance to or a sense of responsibility for it.... The alteration of human identity by new service environments of information has left whole populations without personal or community values.”

(Dixon, 214)

Even though McLuhan was commenting on the powers of television far before we had seen its long reaching abilities to connect and disconnect societies, he fundamentally understood that this wide-reaching medium had the ability to topple empires and instigate dramatic social changes. Those that control news and entertainment distribution can fundamentally reshape the future with positive and negative ideologies.

Bandersnatch is a fantastic example of cross platforming entertainment. In this Netflix “choose your own adventure” television show, the audience is given the opportunity to choose what happens in the narrative by clicking one of two options. Some choices conclude the narrative, while others lead to branching narratives that further develop the central character's story. A central character in *Bandersnatch* explains branching narratives in dialogue with the main character:

“People think it's a happy game. It's not a happy game, it's a fucking nightmare world and the worst thing is, it's real and we live in it. It's all code. If you listen closely, you can hear the numbers. There's a cosmic flowchart that dictates where you can and where you can't go.” (Bandersnatch)

This choice based experimental medium feels like a game because the user experiences the stakes of their choices, but the consequences of those choices are limited because the user can always return to the beginning of the adventure and repeat the process?

During the pandemic, streaming platforms like Netflix, Hulu, and Amazon Prime have moved to capture the current quarantined experience. As a result of the COVID-19 pandemic, streaming platform content is being consumed at a higher rate than ever before. More people are working from home and have a limited ability to safely pursue entertainment outside of the home. A handful of Netflix shows have attempted to tackle the obstacles of creating content during a global pandemic. In “My Next Guest” with David Letterman, guests are filmed from a distance outdoors, or inside with very limited crews. Other shows that continue to film in person have strict COVID-19 testing protocols that require cast and crew to be tested multiple times per week.

Streaming television is attempting to connect with audiences on an emotional level via shows like: “Social Distance” by taking our experience of being behind a screen and exploring the voyeuristic nature of seeing into the private spaces of individuals. Each episode follows a single scenario of a person caught in their struggles in socially distant isolation. In one episode, a man struggles with alcoholism and isolation and begins making videos where he speaks to his plants. The experience of feeling isolated and lonely has resonated with many during COVID-19 pandemic. One particularly interesting component of the show is the way it was filmed. Not only was the show filmed remotely, but it also makes use of cameras that we commonly find in our homes: smartphones,

tablets, laptops, and security cameras. The use of cameras and technology found in most homes seems to be an interesting device for presenting theater, as it directly connects to what most individuals are used to experiencing on a daily basis. Theatre is meant to reflect on the human experience, and now more than ever We are constantly surrounded by high resolution recording devices, whether it be in webcams, nest thermostats, smartphones, laptops, security cameras, or tablets. We use cellphone cameras to record moments we want to remember and reflect on. We use cellphones to connect over social media, scan barcodes for menus at restaurants and bars, and we even use them to monitor our loved ones. The need for high resolution cameras for video conferencing has become pronounced during the COVID-19 pandemic. Many have become accustomed to connecting in meetings with family, friends, and work associates using their laptops, tablets, and cellphones. What was once looked at as novel, has now become an integral part of how we communicate over a physical distance.

Another important component of audience viewership in television is the ability to channel change. This seemingly small agency allows the audience to take control of what they are viewing. When watching broadcast television, we are given the illusion of choice, because we can choose what content we are viewing. This act of channel changing connects with the agency audiences experience while viewing theater, as a result, some form of agency must be employed in order to simulate a theatrical experience. During a live theatrical performance, an audience member has the opportunity to look wherever they like. While in most theatrical video streams one's perspective is dictated within the confines of the video screen.

3. Live Recorded TV

Television Definition: “*an electronic system of transmitting transient images of fixed or moving objects together with sound over a wire or through space by apparatus that converts light and sound into electrical waves and reconverts them into visible light rays and audible sound.*” (Merriam-Webster.com)

Live Television broadcasts have been a part of our popular culture since Harry S. Truman had his speech live broadcast in 1951. Since then, live television has been explored through news outlets, shows like *American Idol*, and sporting events. Shows like *Saturday Night Live* have utilized live television but have since switched to live audience recorded performances. Shows like *American idol* attempt to inject a sense of liveness by allowing the audience to vote and participate in the outcome of the show. While these experiences are interactive because they allow for an audience member to vote on who should win the competition, the audience is inevitably separated from the narrative by the latency of their votes, which often take considerable time to tally. The use of low latency voting for performer and audience relationship can be used to help aid interactivity.

4. Live Streaming

Most people are familiar with video streaming. According to TechJury.com “In 2020, live streaming was expected to account for 82% of all internet traffic.” (Yanev, Victor) These days, anyone can easily create a live video on Instagram, Facebook, Reddit or YouTube by utilizing the camera on their preferred internet connected device. TechJury.com states that “The live streaming market will be worth over \$70 billion by

2021.” (Yanev, Victor) Using social media, people can host their own performances and experiences and get visual feedback from their viewers via a chat or emoticon. “More than 1 in 5 Facebook videos are Live and are watched 3X longer than pre-recorded videos.” (Yanev, Victor) Live streamed content is more popular than ever before. According to techjury.com “There were 3.8 million streamers broadcasting on Twitch in 2020.” (Yanev, Victor) While live streaming has become very popular, especially amongst younger individuals, the experience of using the Twitch website for a live performance may be at risk of falling into a hive mind as the chats and emoticons can overwhelm the needs of a live theatrical production. A simple solution to this problem, is to embed the video from Twitch into a custom-made website, in order to avoid the digital proscenium created by Twitch. Lots of voices can make for an overwhelming experience, where the audience could be more engaged in the chat window with their fellow audience members as opposed to connecting to the performance of the streamer.

Before live streaming was popular, YouTube revolutionized the industry with the ability to upload pre-recorded video content. For years, YouTube has proven to be one of the most popular platforms for audiences. “YouTube live streaming statistics reveal 70% prefer it over other platforms in 2020.” (Yanev, Victor) Many Gamers are now exploring live streamed video of them playing a game in the corner of their screen, while broadcasting their live gameplay. Websites like Twitch make this process easy and user friendly. The user in Twitch is given a chat window to converse with other viewers. As audiences increase, the chat becomes a rapid fire of persons vocalizing their experience and commonly, the audience member’s voice gets lost in the mass of text and responses.

Emojis are employed to rapidly communicate feelings or reactions to the live content, but even then, the content often feels muddled by the flow of audience “vocalizations”. The use of emojis can serve as a simpler way to communicate audience emotion, without complicating the experience with hyper typed text.

While the use of peer-to-peer video streaming technology like Zoom, Google hangouts, and facetime is widely used, the small latencies experienced in these meetings make communication far less fluid than physically in person meetings. Interruptions to vocal communication and the unreliability of internet connection can prove to be obstacles that make this medium a poor platform to host live performances. Fast internet connectivity is essential for a successful digital entertainment experience that exploits low latency response.

Not all streaming platforms are equal. Full screening video in Vimeo or YouTube allows the user to observe, similar to the experience had while watching television because of the elimination of emojis and chat, but if the video is minimized, the audience's experience can be seen via the chat. These platforms do well at hosting video content, but often falter when working with live-streamed performance content, as they have large latencies of a few minutes. Another downside to hosting live content on YouTube or Vimeo is the forced website user interface and branding. Eliminating website streaming user interfaces is important in aiding audience immersion. This can be accomplished by embedding live streamed content directly into a personalized website. With such a large latency and a complete disconnect between the performer and audience, one might ask, what is the point behind streaming live?

5. Live Theatre

Theatre Definition:

“Theatre is a collaborative form of performing art that uses live performers, usually actors or actresses, to present the experience of a real or imagined event before a live audience in a specific place, often on a stage.” (Merriam-Webster.com)

During the COVID-19 pandemic, the theater industry has struggled significantly to connect live audiences to live performances given the restrictions associated with gathering groups in person. Many Theatre festivals, Opera houses, and Playhouses have canceled their seasons. (playbill.com) Theatre requires the live connection between the audience and the performer. When the shared space of both parties is eliminated, the power of theatre is often lost. Theatre companies have streamed live recorded productions for years. The Metropolitan Opera has been streaming live recorded shows for the past fourteen years. These recordings are captured via multiple camera angles, and have a high production quality, but they often dwarf the significance and scale of large opera productions. Additionally, unamplified sound is the most important component of opera, and this is immediately lost- even with the best microphones and engineers, when the user is outside of the physical space.

Experimental theater groups have explored live streamed shows since the advent of the internet. These experiences span the gamut, from interactive pieces that allow the audience to animate a performer, to zoom style performances far before COVID-19 Era restrictions. These experiences can feel as though they have a lower production quality, because theatre makers may be making content from an audience perspective, oftentimes

attempting to record the production with little attention to the cinematography of the piece but instead recording from the fixed perspective of an audience member. When the camera becomes the audience, many of the theatrical rules for blocking, movement, and expression are no longer relevant. Film requires subtlety in action, lighting, and physical space; compositional decisions must be made to support the point of view of the camera, a singular perspective, but theatre is often created with the lens of entertaining many eyes from different perspectives, at varying distances from the stage.

6. What do these mediums do best?

Video Games excel at interaction and the development of stakes for the user. A well-designed game can be engaging, exhilarating and dopamine-releasing for the user. They often allow users to engage in an experience with one another that can't be achieved without the experience of shared stakes

Television typically has the benefit of having larger budgets, more time for post processing and larger editing teams, meaning that making high quality video, with excellent sound, editing, and a variety of compelling camera angles is far more likely to be achievable in comparison to the resources available to most theatrical companies. In addition, television sets are designed with wild walls in mind (walls that can be removed to allow for cameras to track through the space) providing flexibility in filming angles and perspectives. With this in mind, a live recorded Theatre might benefit from making mobile scenic elements that can be moved to allow for new camera angles. In television, all design choices are surrendered to the content creators. The ability to make multiple

attempts at a single shot means that more complex video angles can be achieved. The ability to edit allows the production to take on a more polished look. Experimental television shows like *Bandersnatch* begin to bridge mediums with their approach to delivering choice to the audience. Live interactive television brings the power of democracy into play, by allowing participants to feel their collective voice being heard.

Live streaming provides the user with the ability to connect to the hive mind. Chat bars and emoticons make the live streamed performance more dynamic, and far more engaging for an audience that is interested in conversing with other viewers and occasionally interacting with the performers.

Theatre is still the best at connecting the performer and the audience. The experience of “liveness” can be seen in a live music show, a sporting event, and a play. The collective energy and breath, coupled with the oceanic rhythm of small gasps or laughter attached to collective pupil dilation makes theatre feel the most connected. Theatre is an ancient art form. Before the proliferation electronic mediums, Theatre entertained audiences for thousands of years. The concept of liveness is one that requires all parties to have their attentions turned to a central form of entertainment. Liveness is an ethereal sixth sense, an energy that permeates a connected space, where both audience and performer are engaged in the retelling of a story. Liveness is experienced in large sporting events where the energy of the spectators takes on a collective thought or hive mind. A similar experience can be felt in movie theaters, but the missing component is the live performer or athlete. Liveness is incredibly hard to define and explain because it's not tangible; it's like haze in the air, shared: where the audience feels connected to one

another, breathing in the same air, and experiencing the senses in unison together. These experiences have been missed more than ever during the COVID-19, when we have been socially distant, isolated, and physically disconnected from others.

My question is: How to leverage the advantages of these mediums and create experiences that speak to audiences and performers that are socially distant, at home, and hungry for something more.

7. Creating Virtual, Interactive Narratives

The key to creating compelling interactive virtual entertainment is in the combination of the above-mentioned mediums. One cannot simply rely solely on the strengths of television, theatre, or gaming, because the rules of these mediums are no longer rigid in a digital, virtual space. With this in mind, I selected the strengths I perceived of each medium and employed them in an original system that hopes to bridge the gap in liveness we frequently see between performers and audiences in virtual theater performances in a socially distant world. I took the opportunity provided through the Texas Performing Arts and Fusebox producing organizations to explore the capabilities of this system through an devised piece called: “K!:DD:Ö” an audience interactive entertainment piece consisting of five characters arranged in the setting of a five bedroom house performed by the Frank Wo/men Collective [See section: B. Advertisement description of the performance p. 23].

II. Test of the System

A. RESIDENCY

In 2017 I helped co-found the Frank Wo/Men Collective (FW/MC), an Austin, TX based, ever-evolving group of interdisciplinary artists from various communities. The Frank Wo/Men Collective collaborators co-produce a multitude of forward-thinking, highly physical pieces which are at times fervid, contemplative, or idiosyncratic. Our work is underpinned with intersectional social awareness, gender expressionism, Freudian curiosities, body positivity, and absurdist exploration. From a squeaky toy glutes band and a marshmallow-mouthed opera to poignant duets, submerged headstands, and water torture slip-n-slides, Frank Wo/Men puts forward risky work, no-holds-barred.

With each new project The Frank Wo/Men Collective blends genres and sensibilities to evoke new, stimulating, and often maximalist experiences. When we devise work, each Frankie is encouraged to throw their boldest impulses into the mix. What bubbles up is usually a tantalizing, frequently absurd, interactive and multilayered creation. On our larger projects, I serve as the Scenic/Lighting Designer, as well as the Technical Director.

When Texas Performing Arts (TPA) and Fusebox approached the FW/MC about a new residency, we began pondering what making theater in the COVID-19 era meant. Our shows rely on audience participation and interaction, as a result we began considering what mediums might need to be employed in order to allow for this experience to occur, both for performers and our audience members. We concluded that this show would combine the liveness of live streaming, the stakes of video games, the

polish of film, and the audience/performer connection found in theatre. This ambitious task led us on a path of discovery, frustration, constant obstacles, and a measure of success.

Time in the space together is vital to the devising process. Devising during a pandemic has proven especially difficult because our collective relies on closeness, communion, and the ability to connect emotionally and physically in a space. Without these familial comforts, our process had to adapt. In the past our rehearsal and devising processes have been wild explorations of play and laughter. During this process the rehearsals and devising felt far heavier and darker. The burden of the pandemic could be felt in the weight of the room. Communication breakdowns among collaborators were a constant, largely due to the nature of social distancing and limiting physical exposure to one another. There were multiple COVID-19-positive scares that forced some “Frankies” to participate in rehearsal remotely. Although communication had its moments of strain, the collective hugely benefited from rehearsing in the theater space where we had built our large six-bedroom house which we equipped with our bespoke “Frankensteined” technology.

B. ADVERTISEMENT DESCRIPTION OF THE PERFORMANCE

Stemmed from the magical seeds of our childhood, we created five rooms — each a unique home space that possesses its own sneaky, sneaky bells and whistles. Five live child-adult characters begin the production in a mock Zoom video meeting room and as the production unfolds, we see their personalized rooms from wild and engaging

perspectives. The audience has the ability to observe them through twelve potential camera views with increasingly interactive rounds of influence.

Amidst the weaving of the five's kooky psychodynamic journeys, this pseudo-“Sims” live action experiment engages the audience with a User Interface hosted on our website, that— through a series of easter eggs and digital buttons — allows the audience to modify the environments, play games with the characters, and even control taste while sharing the experience with their fellow audience members through commonly accessible cameras on our bespoke website interface.

The duration of our residency and devising process in the theater was limited to three weeks. The first week was spent installing the set: a six-bedroom house, with a bathroom, kid's playroom, closet, garage, and bedroom. Throughout the first week various technical elements were added, lighting, projection, cameras, and computers. The second week was spent devising and testing the technical systems that had been built. At the end of the second week, we had technical rehearsal through all of the potential storylines.

III. Design of the system

A. USER INTERACTION

In Theatre, the audience is frequently considered to be a passive viewer. In some interactive Theatre pieces, audiences are given the opportunity to interact with live performers. The Frank Wo/Men Collective is committed to delivering interactive performances that push against the audience being passive viewers. To support this commitment in a virtual context I designed a system on a new website for the Frank Wo/Men Collective that houses virtual interactive control buttons that at any given time allow the audience to vote on the directional narrative of the show and respond to moments that they enjoy or dislike. Based on best practices from gaming and live television, I've learned that low latency voting, and audience feedback can help reveal the realization of stakes and help elevate a sense of liveness.

Within the devising process of K!::DD:Ö we realized that the production would require low latency interactivity and an audience/performer relationship. In order to create such an experience, we created a place for audiences to vote on the narrative, and a space for audiences to join with their own video stream. Creating liveness in a web browser is no small task. The surrounding digital space around the video content is as important as the content being displayed because that surrounding area becomes the digital proscenium of the production, defining the window into that world. The addition of a space for audiences to add their own video stream within the performance meant that each small audience video window became a portal into their worlds; with their environment being reflected in the show, they became part of the production. Those

audiences video streams, voting, and emoticons were then piped directly to our performers, live, with low latency to artificially create an audience and performer feedback; with these additions, it was almost as if the performers could make eye contact from the “stage” with the audience. When audiences clicked buttons on the website a variety of tasks were instigated. Each button click sent a small MQTT (Message Queuing Telemetry Transport is a lightweight, publish-subscribe network protocol that transports messages between devices) message to local server (a computer on location), which would then interpret those messages to perform a task. Those button presses by the audience were used to tally votes and generate live reactions, but in future iterations of the system these messages could be used to: change lighting, change video effects, manipulate camera position, and any number of options that could be conceived. In order to keep the experiment simple, we chose to interpret those messages to tally votes and trigger emoticons that floated across the screen at various intervals during the performance. While this system of interaction isn’t nearly as powerful as physically sitting in the space with other audience members and performers, it creates a new heightened experience that can excite audiences with the opportunity to be involved.

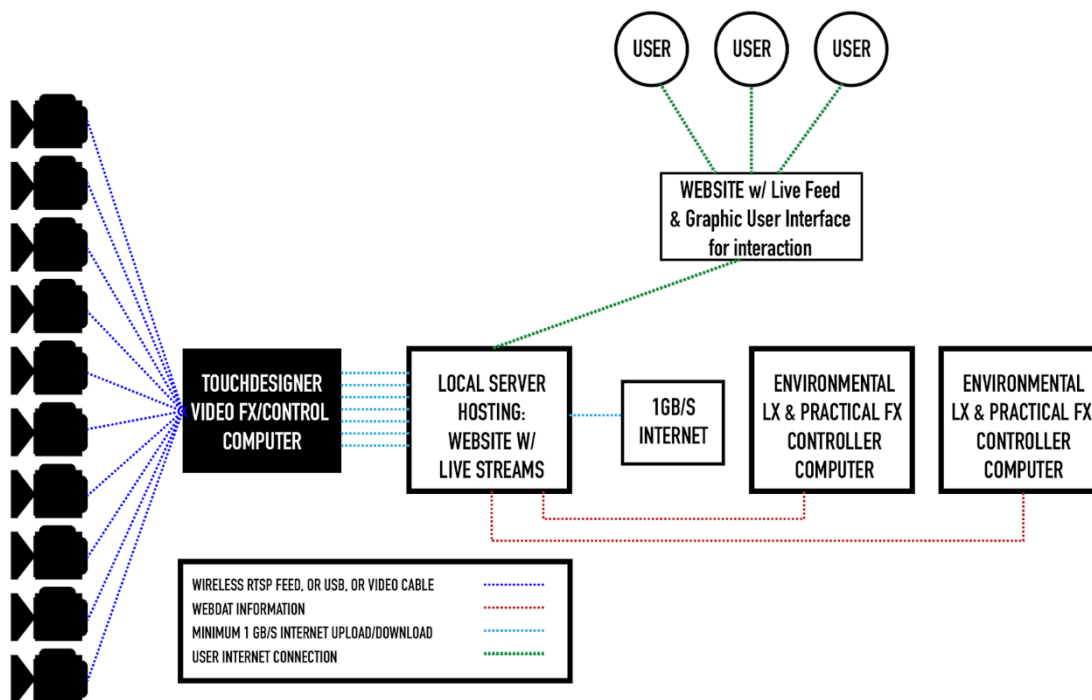


Figure 1 K!:DD:Ö User Interaction Diagram

B. CURATING THE WEB BROWSER

A key design consideration in creating an immersive interactive virtual experience is the creation of a custom website. In virtual Theatre experiences, the web browser becomes an extension of the world, a virtual proscenium. Forfeiting the opportunity to curate the world surrounding the “stage” is a missed opportunity for immersion. Hosting a performance on YouTube, Vimeo, or Twitch forces the audience to create associations with their experiences on their pre-existing platforms. The surrounding environment can be just as important and exciting as the performance itself, which is why some productions are so much more entertaining in a found warehouse space, or in an

abandoned building. If the surrounding virtual proscenium isn't neutral, then it becomes a part of the storytelling initiative.

In addition to curating the space surrounding the video window on the website, I designated a space directly below the main video window that allowed audience members to join with their own video. This composition allowed for audience members to see the reactions of their peers and interact with one another. This low latency audience feedback proved to be far more engaging than a chat window because it allowed the audience to become performers in their own right. These video feeds could then, at the request of the performer, be projected into a performers space: one of five rooms within the set, so that they could see how the audience was responding to their performance at any given moment.



Figure 2 K!DD:Ö website user interface

The five buttons on the right of the user interface allowed the user to switch between one of five rooms like channels on a television. The five buttons below the video surface were used to vote and give live feedback. A performer could ask the audience to respond to a question by selecting one of the buttons, those responses would then be projected onto one of the walls the performers were housed in.

C. DIVERTING STORYLINES

Within the production of K!:DD:Ö we created interaction in the live performance by allowing audience members to have agency in the branching narratives they observed by choosing which room they watched and by allowing audiences to choose the outcome of certain storyline interruptions. The audience observes these varying storylines in two ways: by choosing which performer track or channel they follow, and through live audience voting. In K!:DD:Ö there were various moments when the audience was given the opportunity to decide the storyline. Depending on the democratic choice of the audience, one of five diverting storylines was presented to the performers. Additionally, audience members could click emojis (the buttons at the bottom of the screen) during the show to help individual performers form their narrative track. A performer could ask “Should I turn into an angel or demon? Click the blue button for angel, and the purple button for demon!”. Within seconds a flood of floating emojis appear for the performer to respond to. This limited feedback feels engaging for the performers, while limiting the user’s interactivity to a place where the audience reaction can be contained in order to

keep responses comprehensible and digestible for the rest of the audience without chatting and unrelated commentary to the live production.



Figure 3 K!:DD:Ö Story Arc and Diagram

D. CONSTRUCTION OF THE SYSTEM

1. System Diagram

The system used for K!DD:Ö required the use of over twenty computers. One computer (video switching computer), custom built for the production, was devoted to handling eleven different camera streams, and routing them to one of six streaming computers. Those six computers streamed a live camera feeds to Twitch. These feeds could then be embedded into our custom website.

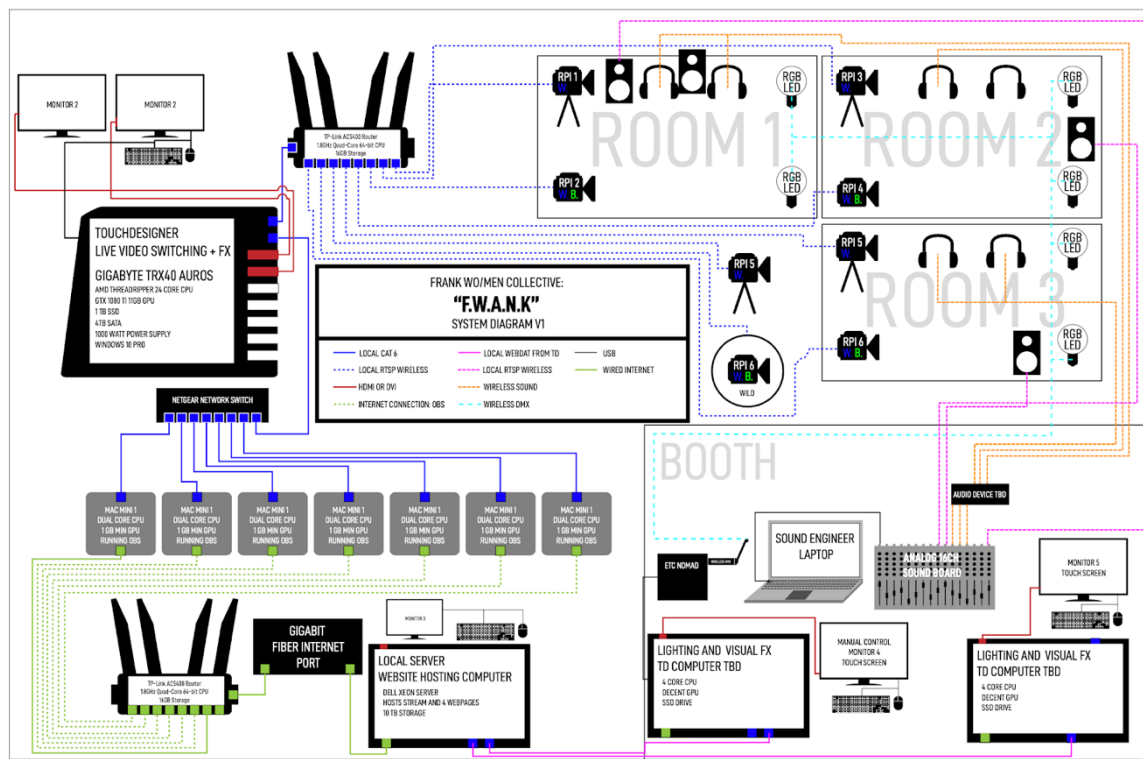


Figure 4 System Diagram

Five stationary cameras were hardwired into the video switching computer, and seven wireless cell-phone cameras running a Network Device Interface (NDI) app were used to capture a variety of first-person point of view and third person point of view. The

streaming computers were hardwired into an ethernet switch connected to a gigabit internet connection.

One high powered router handled all of the wireless NDI video streams and wireless lighting. One computer served as an intermediary between our router and our Phillips hub lighting network. That computer was hardwired into an Eos Ion lighting console to allow control of the Phillips Hue lightbulbs via cueing and remote control.

The digital soundboard received wireless microphone audio from each performer and then sent that audio with unique soundtracks to six individual USB interfaces that were connected to each of the streaming computers. One computer served as a projection content computer, sending content to all five rooms separately.

2. TECHNOLOGY EMPLOYED

After months of preparation and independent testing, an assembly of hardware and software was chosen in order allow for the successful implementation of the K!:DD:Ö production. These solutions were chosen for their cost effectiveness, ease of use, and ability to bought during a shortage of hardware during the COVID-19 pandemic. The abbreviated list that follows is included to aid others in the journey towards creating and iterating upon the production system we pioneered.

a. MQTT, Website, streaming, live video

Utilizing (Message Queuing Telemetry Transport) OR MQTT rapid messages were sent from the website through a networking broker that allowed us to rapidly fetch the data of those messages and interpret it in visual representations within Touchdesigner,

whether it be via an emoji animation, video effect, or a vote for a storyline shift. These low latency, low bandwidth messages allow for audience/performer response in rapid time. In order to make full use of MQTT, a remote server broker is needed, a service that serves as an intermediary between destinations. While we started by using a free broker, we quickly realized that for reliability we would need to establish our own server. We did that by purchasing a small, partitioned Amazon Web Services server.

Our website was built using a stripped-down (HyperText Markup Language) or HTML that didn't rely on flash or complicated programming. After researching website development, it became very clear that creating a simple website without flash and minimal programming would allow for quick access speeds by a variety of devices and would expedite development. Keeping the website lean meant that the production could be viewed on any modern device: laptop, computer, tablet and even cellphone. The more content that is hosted on the website, the slower the site will load on all devices. It's important to consider what devices the audience will use to view and interact with the experience. For our purposes we focused on optimizing the website for laptops, tablets, and smart televisions; while the performance could be viewed on a cellphone, the limitation of resolution proved to make interaction more challenging from an audience perspective, because audiences would have a hard time clicking buttons and navigating. The website was meant to house multiple video streams on a tracked narrative. There were six pages, one page per room, and a home page. The goal was to control the entire graphic design user interface and in doing so create a more cohesive and curated experience for the audience. While we are not website developers, we created simple

ways of heightening the perceived production quality of the website by using custom gifs (a lossless format for image files that supports both animated and static images) emoticons, and digital artwork. The key was to keep the file sizes small enough to not bog down the loading times of the website, but large enough where the resolution and quality wasn't sacrificed. The use of gifs allowed for simple animations without writing java (a class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible) scripts. The use of gifs allowed the production to lean into its late ninety's aesthetic. The original space jam website served as a source of inspiration.

b. Peer to peer video streaming

OBS.Ninja is a free and open-source peer to peer video streaming platform. Using OBS.Ninja, we managed to stream multiple cameras simultaneously directly to our website while also allowing audience members to join with their own video on the website, in a little bar below the main video. While latency may not seem like an issue for most streamed performances, a streamed performance with audience interaction and high latency could prove to further separate the audience from the show. The low latency of OBS.Ninja also allowed us to pipe audience reactions and interactions back to the performer via our projection surfaces. This close-to-live feedback allowed the performers to respond quickly.

OBS.Ninja has its limitations. Due to its peer-to-peer structure, anytime an audience member views the content it requires the computer hosting the content to send it

to them. This means that each streaming machine will require a substantial amount of processing power and bandwidth. In an ideal world, these streaming machines would be a high-powered server rack that was engineered to handle the loads generated by peer-to-peer streaming. These limitations meant that we were significantly limited on how many audience members could view any one stream at a time. This number is completely dependent on the computer hosting the video content and the CPU, GPU and internet bandwidth available. We found that our number was around 10 per streaming device. This was not enough for our needs and after a system stress test, we decided to move to hosting our live stream through twitch, embedding the content directly into our website.

c. Touchdesigner

Touchdesigner is a wildly diverse piece of software that allows for data fetching, live video manipulation, projection mapping, and compositing. The needs of the K!:DD:Ö production required that multiple streams have the capability to be manipulated and switched. While video switching hardware and software exist to fit these needs, they are often prohibitively expensive. With this in mind, we used Touchdesigner to create a custom live video switching and manipulation interface that allows us to seamlessly switch between effects, cameras, and projection content. Touchdesigner also allowed us to receive messages from our website and then interpret those messages into actions. Touchdesigner could be used to control lighting, video effects, and even trigger audio cues. In K!:DD:Ö touch designer was configured to receive messages via MQTT to tally votes and trigger emoticon animations. This seemingly simple solution has endless

opportunities. Using Touchdesigner any number of sequences or actions could be triggered as Touchdesigner excels at receiving inputs and outputting data, whether that be visual content, audio, or data. Within Touchdesigner, NDI, DMX, OSC, and many other protocols can be received and sent.

d. Networking

Getting all of the technology to communicate was a massive undertaking. The wired and wireless networking involved in K!:DD:Ö proved to be one of the largest challenges. Each wireless camera device had to funnel through the local router, and then into the local video switching computer, which would then send them over wired NDI to each separate streaming computer. Each projector and wired camera required HDMI extenders that ran over cat6 cable. In order to smooth the process of bandwidth access and the internet router frequencies available on the University of Texas campus, we worked with the College of Fine Arts Information Technology and the University of Texas' Information Technology networking department. In order for our routers to be able to communicate, we had to request that certain internet frequencies be removed from the university's routers in the theater. We used a single local network that was broadcast from a Nighthawk brand internet router; this router did the bulk of the data transfer between computers in our system both wirelessly and via ethernet. Most of the bandwidth used was in transferring wireless camera feeds via Network Device Interface (NDI). NDI is a video networking protocol that allows for low latency HD video feeds to be sent and received via senders and listeners. We received all seven of the wireless camera NDI

feeds to our video switching computer running Touchdesigner, these feeds were then sent to the streaming laptops on demand, which used OBS to broadcast the video feeds to twitch, which were then embedded on the website. Our video switching computer did not have enough video inputs or capture cards to receive the fixed camera views, so those video feeds were intercepted by the projection computer and then sent to our video switching computer using a single high resolution OBS NDI feed. The video switching machine then created five unique NDI streams that were sent to the streaming computers on demand. The resolutions of the feeds were limited to 720p across the system, so that our local network could handle the bandwidth, and the user could handle the bandwidth needed to watch the performance on their end. We used this router to communicate to our hacked Phillips Hue lighting system which in turn communicated with another laptop that served as a server in between the hue system and the lighting board.

e. Computer Communication

We employed over twenty computers and handheld devices. Six computers received content from the video switching computer and were used solely for the purpose of streaming to our website. The main computer that handled the video switching and MQTT messaging receiving both wired video, and wireless video. Another computer output video feeds to five projectors.

The lightboard was its own computer. An additional computer served as the server for the Phillips Hue lighting system. The digital sound board was its own computer. There were then seven devices (cell phone, tablet, laptop) that were used to

send wireless camera feeds from each room. Another two personal computers were used to fill in the tech blanks and monitor the live website and ensure that audience members were not sharing illicit content during the performance.

One of the obstacles encountered in the creation of the piece proved to be hardware related. A computer is only capable of doing what it has the capacity to do. In order to handle all of the video feeds and video effect manipulation, I built a computer from scratch, paying close attention to the CPU, GPU, and networking capabilities needed. After researching for months, I ultimately created a very capable PC with the ability to handle 16 video streams at once. One limitation encountered in the installation process was the need to input wired video feeds. The PC I built did not have video inputs or a capture card, only outputs. This meant that the wired video connections had to be piped through a different computer, and then sent to the main video switching computer.

f. Hacking Existing Internet of Things Devices

In order to sell the look of the show starting in a Zoom call, the collective decided to employ practical lighting (fixtures that fit in standard electrical receptacles) for the main lighting in the piece. This meant that lamps and overhead light fixtures could be controlled via the house lighting console. Achieving control of the lighting happened in two ways. The first is through portable dimmer packs that control incandescent fixtures.

The second way we controlled the lighting in the space was by hacking the Phillips Hue colored lighting in the space. Phillips Hue bulbs are WIFI connected bulbs that allow for color changing on command via the Phillips “bridge”. The Phillips bridge

served as a small router and connected to our local Nighthawk router and acted as its own transmitter, sending signals to each bulb. While this is a nice feature, the Phillips Hue software is quite slow and limited in its ability to control its lighting. The built-in dimming curves of the fixtures are seconds long and require the use of a cell phone app to operate them. In order to better sell the psychedelic look of our piece, I set up a computer to run as a client between the lightboard and the Phillips hue bridge. This allowed me to manipulate the lighting five times faster, and run effects, all from the convenience of the EOS ION lightboard. This was helpful, because practical lighting was needed in order to preliminarily sell the idea to the audience that the performers were in a house, an illusion that we break as the piece unfolds and the audience realizes that the space was in fact a set.

g. Live Video Manipulation

Another important component of this show was the ability to distort, effect, and manipulate the live video content. This ability allows for the live video to feel more polished and cohesive. In our show this was done through the bespoke creation of video effects, switching, and original content overlays within Touchdesigner. Not only were we capable of overlaying custom-built content, but we could manipulate the video feeds to give off the impression of a video “glitch”. In addition to dressing our live video on its way to the website, we could also reroute said video to our projection surfaces in each performer’s room, allowing the performers to interact in live time, with limited latency: audience reactions. The ability to change camera views and overlay content was

particularly important to this show because we had so many devices. While there were five concurrent shows happening within the K!:DD:Ö performance, we had the ability to switch between devices with ease.

Using our custom-built video switching and manipulation software, we were able to disrupt the common use of rectangles as the video viewing template and show the video through any shape we designed. In K!:DD:Ö, we frequently played with the overlay shape the video content was behind. In one moment in the piece, we divide the viewing space into five circular windows that were then animated throughout the video surface.

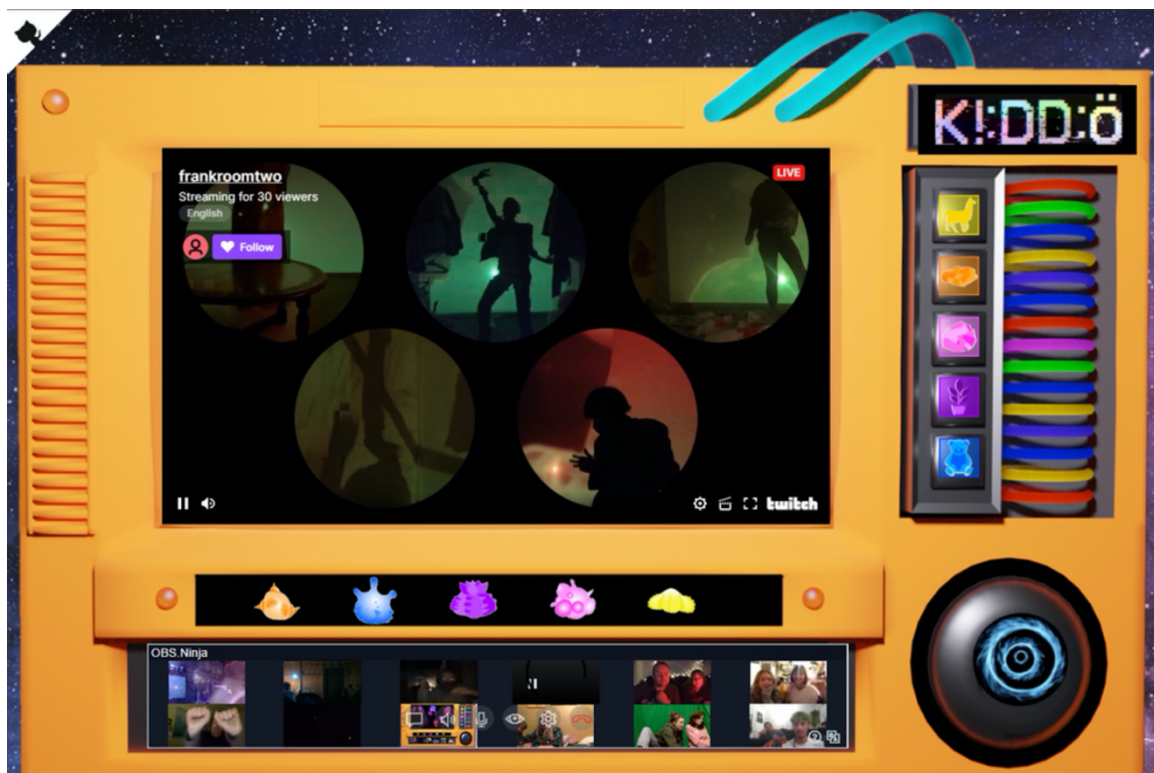


Figure 5 disruption of the typical rectangular video screen

h. Audio

A challenging component of all live entertainment is audio. Due to the complex nature of K!:DD:Ö, with multiple shows happening concurrently, we decided to employ actor-worn lavalier microphones and inner ear monitors to ensure that we had clean capture of vocals, and clean audio feed to the performers. In order to get the audio on to the website, each computer had to have an audio interface, a device that took audio from our soundboard, and converted it into a signal recognized by the computer as an audio input. Another obstacle we had to face is the delay between audio and video. As the video travels across our network, a small latency is created due to video processing and encoding time, this means that the audio has to be slightly delayed in order to sync with the video content coming out on the website.



Figure 6 Schivona Johnson Audio Engineer and Designer

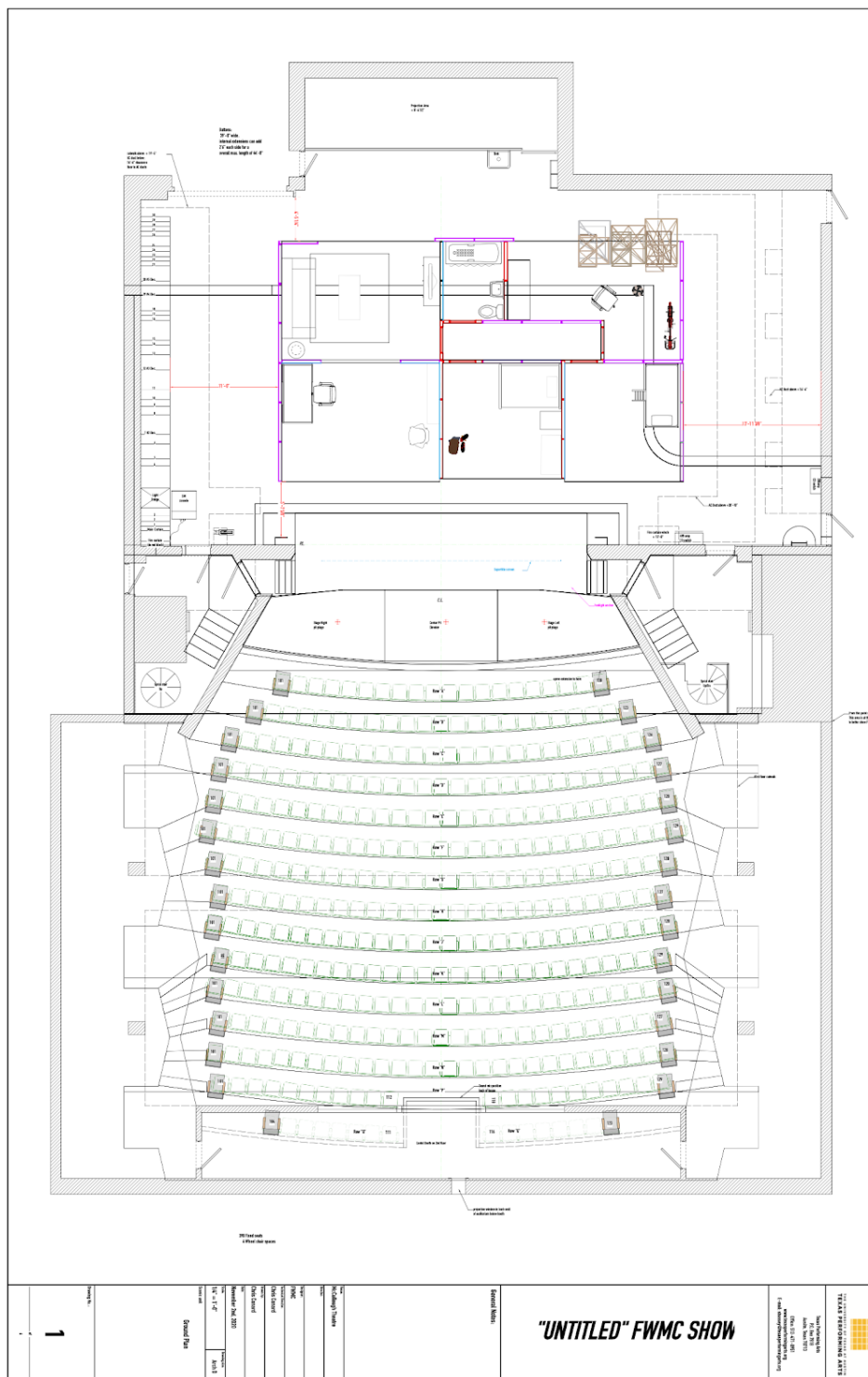


Figure 7 K!:DD:Ö Ground Plan: not to scale



Figure 8 K!:DD:Ö Top Perspective View Rendering

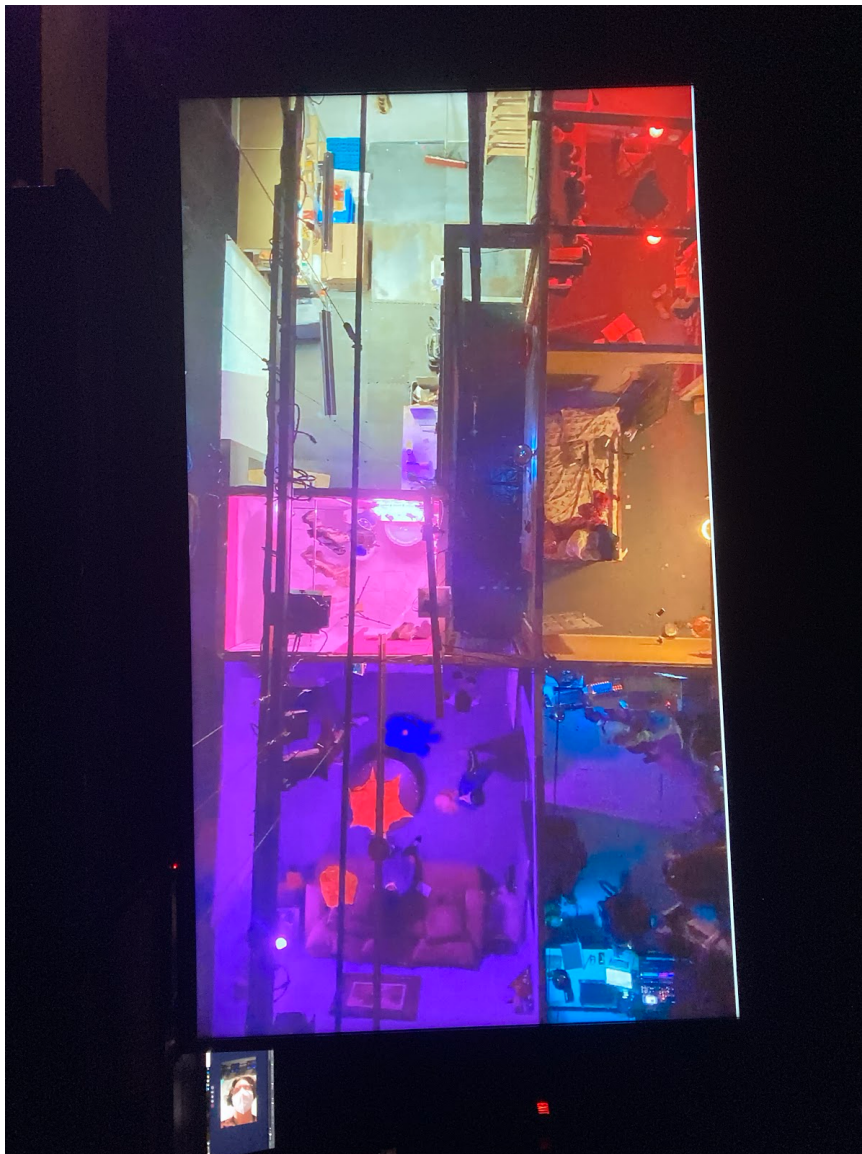


Figure 9 K!:DD:Ö Top Camera View Photograph



Figure 10 Process shot of K!:DD:Ö

IV. Design and construction of the performance environment

A. SET

My original intention was to design and build five completely different worlds: An arctic room, an alien room, and a post-apocalyptic obstacle course. After brainstorming with the whole collective, I opted to create a house, so that each performer could have a hand in curating their space as they saw fit. Our intention was to connect to the audience feelings of being quarantined at home. Each room came with its own tricks and technology: a wireless camera, a fixed camera, a large projection surface, and some mechanical installations.

Khali's Room

Inspired by a kid's playroom, Khali wanted her performance to be child-like and innocent, with a fashion show, puppets, and a shelf full of lava lamps; Khali's space was playful and boasted a large couch, and a coffee table. Khali quickly realized that she could stretch one of her costumes over the coffee table.



Figure 11 Khali's Room

Kelsey's Room

A bright yellow kid's bedroom with a small bunk bed, Kelsey's room displayed a curated collection of imaginary friend components that the audience selected. At a particular moment in the show, the imaginary friend would come to life, with an arm shooting through the wall, engaging Kelsey in an epic battle.



Figure 12 Kelsey's Room: Kid's bedroom



Figure 13 Kelsey's Room: Showing projection surface

Alexa's Room

A littered garage with peg hole tool storage, work bench, and metal shelving, Alexa's room may have seemed like a strange place to play, but her acrobatic jedi play brought the space to life. Alexa's plot involved fake "force" tricks where she would push and pull objects off of shelves, by manipulating them with magnets hidden in her hands. At the climax of her room, using live video effects she engaged in an epic lightsaber battle with herself.



Figure 14 Alexa's Room: The Garage



Figure 15 Alexa's Room: Showing Live Video Manipulation of Projection surface

Roberto's Room

A small pink bathroom, with shower, sink, toilet, and medicine cabinet, Roberto's space had a few illusions up its sleeve. The shower curtain doubled as a projection surface. When Roberto wasn't talking to his pet plant "Natalie" he accepted phone calls from the audience. At the climax of his room, he crawled through the medicine cabinet into Alexa's garage room space.



Figure 16 Roberto's Room: Bathroom



Figure 17 Roberto's Room: showing projection content on shower wall

Erica's Room

A closet space full of clothes, Crown Royal bags, and a miniature skeleton, Erica's space was meant to resemble her parents' closet when she was a kid. She and her pet rock "Jett" took the audience on a journey to become a demonic angel. At the climax of her room, the closet was bathed in orange and red light, with flames as a backdrop.



Figure 18 Erica's Closet: Showing emojis across screen

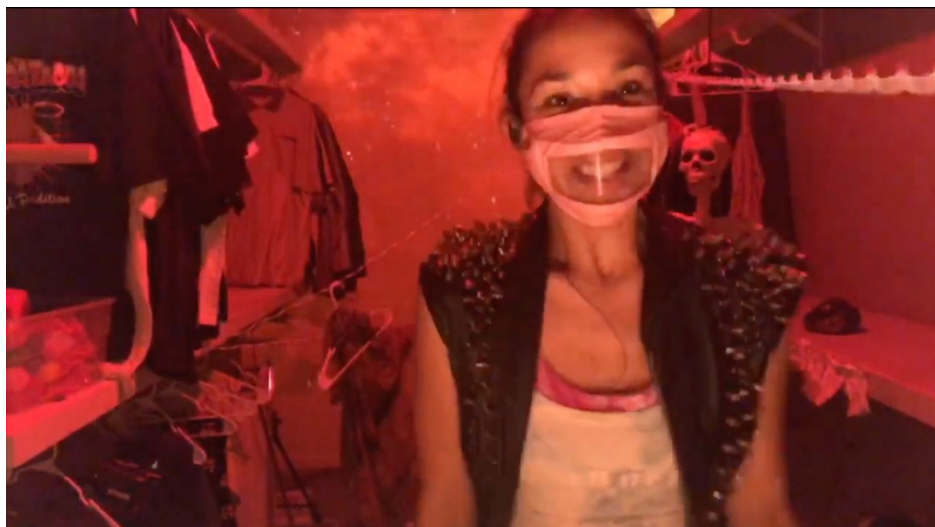


Figure 19 Erica's Closet: Showing emojis across screen

V. Critics Response

David Glen Robinson reflects on his experience of K!.D.D.O in the review below.

“K!.D.D.O. was not a Zoom meeting, although the show employed the at-home computer cameras on spectators' laptops to project our images back to the producers. That feed and additional software enabled audience interaction in choosing “voting” decision points, so the audience defined alternative pathways through the performance.

The technical designers achieved a well-designed and smooth-running cyber structure for the show. Kudos to them, but as an audience member I spent ‘way too much time learning what to click and what to leave alone. As a result, I didn't manage to visit all five rooms of the performance over the course of the livestream. But this is the plague-cursed 21st century after all, and a significant degree of computer savvy on the part of audiences was a reasonable expectation on the part of livestreaming producers, so my own “clickosis” ultimately caused no major ding.

The stuff of K!.D.D.O., its meat, was a prop- and costume-heavy psychological evocation of childhood. The rooms of the house each described the childhood space of a principal performer, with game-like activities offered to the audience on their computer screens. Performers took objects and materials and transformed it all into imaginative surfaces for storytelling and abstract and descriptive imagery.

The performances revealed the absurdist liberty of all children and pointed out the surprising harmony with the Frankies' Number 1 (absurdism). The performers revealed their ability to access childhood magic, something lost to many adults.

But this is not Christopher Robin's closet full of forgotten toys, pixelated [sic] Winnie-the-Pooh in stasis. The performers were cyber companions with whom we were invited to play using the language of point-and-click. Their efforts were seductive, and after melding my brain and my loyal trackpad into a single instrument, I pitched forward in that long dreamlike fall into the kaleidoscopic menagerie of a child's imagination.” (Robinson, CTX Live Theatre Review)

VI. Conclusion

At the beginning of this journey, we sought to create an experience in which the audience and performer could communicate and interact. This need forced us to create bespoke software systems and connect devices through an increasingly complex network. While the full extent of this technology has not been met due to the time constraints of the residency, the lessons and systems created in the residency can and will be employed to further extents in future shows and experiences. The use of live, low-latency audience feedback to the performer has the potential to aid in the missing connection experienced with most live streamed theater. The addition of audience camera sharing gives the audience an opportunity to respond to one another and share in the experience. While in K!:DD:Ö we chose to eliminate audience microphones, this option could be utilized in the future to create more call and response between the audience and performers. The key to creating compelling and exciting interactive live streamed performances is the close attention to detail to what and how the audience and performer interact; special care must be given to curating the user interface, designing the moments of interaction, and generating moments of audience and performer feedback. If too much liberty and agency is given to the audience, this may prove to distract from the intentions of a semi-linear storytelling experience. On the other end of the spectrum, if too little agency is given to the audience during a performance, the experience can feel stale and far less engaging.

A myriad of lessons was learned in this devising process:

- The surrounding digital proscenium of a live interactive production should be curated to match the world of the production

- The MQTT protocol can be used to send lightweight messages from a website to a local device. Those messages can be used to manipulate aspects of a production
- The illusion of agency can aid in audience engagement
- When creating a custom website, one should consider what devices may be using it
- The use of open-source technology can prove helpful in creating interactive live performances on a budget
- Building computers and systems for specific purposes can be an efficient way to avoid costly name brand devices
- Audience/Performer feedback is a key component in fabricating liveness
- Testing and iteration are important in revealing problems that may occur ahead of time
- Communication between collaborators is paramount to the success of a production
- Tech time in the space is incredibly valuable
- When working in a large institution, partner with the Internet Technologies department to ensure that you have the necessary internet bandwidth available and router frequencies

Not only were lessons driven by technology and computers, but they were also about communication between humans. At the core of all good entertainment is the humans making the work. If communication lines are strained, then trust between

collaborators can be lost. A loss of trust in the devising process can lead to massive limitations in the final product. When collaborators lose trust in each other, emotions can have a negative effect on the free flow of ideas and creativity and resentment can begin to disjoint and separate the devising process. If we were given the opportunity to do this residency again, clarifying roles and expectations from collaborators would be of high priority. Additional production meetings and rehearsal times would have also aided the process. Overall, more time on all fronts would have allowed for far more to be accomplished and to be explored. In the end, compassion and empathy should be utilized to better understand and connect with collaborators in a devising process. With the lessons learned on this project, I'm confident that we could take this model of devising and creation and craft compelling new work that continues to push the boundaries of what is commonly accepted and explored.

When creating interactive live entertainment, the production should not be limited by cameras and camera equipment; the use of cameras and technology found in most homes seems to be an interesting device for presenting theater, as it directly connects to what most individuals are used to experiencing on a daily basis. The act of channel changing or the ability for the audience or user to change perspective during the performance heightens agency and can be used to immerse an audience in a digital experience. Giving audiences the ability to communicate with one another through chat, video, audio, or emoticons allows users to have more stake in the performance. The use of emojis can serve as a simpler way to communicate audience emotion, without overloading the audience with written audience commentary. Curating the digital

proscenium is an important component of immersion and engagement; hosting a performance on a pre-existing platform limits the possibility for immersion. Fast internet connectivity is essential for a successful digital entertainment experience that involves low latency response. The right hardware and software is essential, as well, for smooth implementation of a low latency high production quality performance. Interactive live performance should be treated more like a combination of film and game production because film requires subtlety in action, lighting, and physical space while gaming requires the use of level development and branching narrative structure. The video space does not need to be forced into a rectangle but can instead be explored in various shapes.

Live streamed theater should exploit the advantages of multiple mediums to develop a sense of liveness with internet-based audiences. Designing a virtual theatrical experience is larger than what is contained inside of the parameters of a video window. Prioritizing audience interaction and engagement is key to creating compelling and immersive theatrical experiences. Through cutting edge technology old practices of performance and entertainment can be reimaged to breathe new life into the ancient practice of storytelling.

Theatre is often created with the lens of entertaining many eyes from different perspectives, at varying distances from the stage. Even in a digital performance, the collective energy and breath of the audience, coupled with the oceanic rhythm of small gasps or laughter attached to collective pupil dilations of the audience can make a live digital performance feel more like Theatre, by connecting the audience and the performers. Every challenge is an opportunity; My role as a multi-disciplinary designer,

fabricator, and producer on Kiddo allowed me to explore a wide variety of technological solutions to obstacles found as a result of time and budgetary limitations. Many of the current technological developments employed were created as a response to the COVID-19 pandemic and the social distancing we all experienced over the course of a year. For instance, OBS.ninja was developed as an open-source tool to allow for people to connect for free. Much of the system deployed for Kiddo was made possible by anonymous strangers across the globe. The push to create open-source solutions is an exciting and refreshing trend in our digital era. In the end, the obstacles of a live virtual performance experience should be looked at as an opportunity to explore a new medium versus forcing Theatre into a mold that it doesn't fit.

Glossary:

MQTT: A standard internet messaging protocol designed to publish/subscribe lightweight messages with a small footprint and efficient network bandwidth. MQTT is used to connect IOT devices and is currently used in a large variety of industries.

NDI: A software protocol that allows for the receiving and sending of high-definition video over local networks in high quality, low-latency, frame-accurate format suitable for live broadcast and live video production.

IOT: Physical objects or “things” that contain software, sensors, and WIFI cards for the purpose of exchanging and connecting information with other devices across the internet.

PEER-TO-PEER: A direct network of computers wherein information and resources can be shared directly without relying on a central server network. Frequently used in low-latency video streaming platforms.

Touchdesigner: A visual node-based programming language for real time rendering and interactive media. Used by programmers, engineers, coders, designers, and performers to create installations, digital performances, and mixed media creations.

HTML: a programming language used to generate documents on the internet incorporating graphics, sound, text, video, and hyperlinks.

SERVER: a computer in a network that is used to generate and access services (such as files and peripherals and the routing of messages) to other networks and computers

CLIENT: a network made up of computers using services such as: access to peripherals and files. Could also be software that allows a computer to act as a client within a network.

PHILLIPS HUE BRIDGE: The central brains of the Hue lighting system, allowing the connection and control of up to fifty lights and accessories.

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