ENCOURAGING LIVE THEATRE ATTENDANCE: INNOVATING WITH THE APPLICATION OF EMERGING TECHNOLOGIES TO ATTRACT CONTEMPORARY AUDIENCES

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Dedication

To my beloved husband, Mehdi,

For being my guiding light in the darkest moments and for your unwavering faith in me. Your countless sacrifices, especially through the challenges of immigration, have made this journey possible. Thank you for standing by my side and for the love and support that have shaped this achievement.

With all my heart, I dedicate this work to you.

Abstract

A Seussified Christmas Carol was presented in Fall 2023 at the University of Lethbridge's theatre, directed by Ryan Reese. I designed this project, taking on the responsibilities of set design and the design and animation of the projection images. The goal was to incorporate emerging technologies into live theatre to innovate and enhance the audience experience, to reach a wider audience. This production utilized Deepfake technology, a holographic projector, and projection screens to feature virtual images of deceased and living famous actors who interacted.

Digital Tools Acknowledgment

I would like to acknowledge the digital tools that supported the development of this thesis. Google Translate, a translation tool, helped me translate my writings from my native language to English. Grammarly, a grammar and spelling checker, assisted in improving the grammar and spelling of my content. Semantic Scholar, an AI-powered research tool for scientific literature, provided access to a range of academic papers and resources. I am grateful for the assistance of these tools in enhancing the quality of my work.

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Table of Contents

DEDICATION ..... **III**

ABSTRACT ..... **IV**

DIGITAL TOOLS ACKNOWLEDGMENT ..... **V**

ACKNOWLEDGEMENTS ..... **VI**

LIST OF TABLES ..... **X**

LIST OF FIGURES ..... **XI**

LIST OF ABBREVIATIONS ..... **XIV**

CHAPTER 1: INTRODUCTION **1**

1.1 Problem Statement 2

1.2 Thesis Objectives 5

1.3 Practical Project Introduction 6

1.4 Thesis Structure 7

CHAPTER 2: ONLINE THEATRE **9**

2.1 Challenges of Online Theatre 12

2.2 The Taste of Today's Audience 15

2.3 Proponents' and Critics' Opinions 16

2.4 The History of Technology in Theatre 17

2.5 Emerging Technologies 21

2.5.1 AR IN THEATRE *22*

2.5.2 AI IN THEATRE *24*

2.5.3 MOTION CAPTURE *25*

2.5.4 SCREEN PROJECTIONS *27*

2.5.5 PROJECTION MAPPING *30*

2.5.6 HOLOGRAM TECHNOLOGY *31*

2.5.7 SPATIAL AUDIO SYSTEMS *33*

CHAPTER 3: EXPLORING MODERN TECHNOLOGIES INTEGRATION **35**

3.1 Innovative Ideas for Technology Applications in Theatre 35

3.2 Audience Reactions to Hologram Performances 36

3.3 Using Hologram Technology in Theatre 37

3.4 Deepfake Technology as an Innovative Approach 38

3.5 Choosing Suitable Hologram Projectors 39

3.6 Optimal Conditions for Hologram Display 40

3.7 Choosing *A Seussified Christmas Carol* Play 41

3.8 Creative Ideas 43

3.8.1 THE GHOST OF CHRISTMAS YET TO COME AS A VIRTUAL CARTOON CHARACTER *43*

3.8.2 COLLABORATING WITH FAMOUS ACTORS VIA HOLOGRAPHY *44*

3.8.3 RENOWNED ACTOR SIMULATION VIA DEEPFAKE AND HOLOGRAPHY *45*

3.9 Design Strategies 46

3.9.1 CREATIVE APPROACH *46*

3.9.2 PROJECTION SCREEN *47*

3.9.3 PROJECTION SCREEN DESIGN *49*

3.9.4 INSPIRATION FROM THE NIGHTMARE BEFORE CHRISTMAS *52*

3.9.5 LINKING CHARACTERS *53*

3.9.6 CREATING DISTINCT SPACES FOR DIFFERENT TIME PERIODS *54*

CHAPTER 4: IMPLEMENTATION PROCESS **57**

4.1 Selection Criteria and Actor Choices 57

4.2 Director's Decision on Deepfake Technology 58

4.3 Budget Constraints 59

4.4 Safety Regulations and Adjustments 60

4.5 Placement of the Hologram Projector 61

4.6 Displaying the Ghost of Christmas Past on Screen Projectors 63
4.7 Deepfake Technology Implementation 64
4.8 The Process of Utilizing Hologram and Deepfake Technologies 66
4.9 Uploading Videos to QLab Software 68
4.10 New Challenges with the Hologram projectors and Their Solutions 68
4.11 Setup and Placement of Screen Projections 70
4.12 The Process of Creating Screen Projections Content 72
4.13 Tech Challenges in On-Stage Rehearsals & Live Performance 73
4.14 Challenges in Advertising and Poster Design 75

CHAPTER 5: CONCLUSION 79

5.1 Evaluating Audience Engagement and Technological Impact in *A Seussified Christmas Carol* 79
5.2 Reflections and Team Feedback on Technological Integration 84
5.3 Evaluation of Practical Project and Addressing Research Questions 86
5.4 Recommendations Based on My Experiences 96
5.5 Conclusion 97

WORKS CITED 100

APPENDIX A: TECHNICAL DETAILS OF *A SEUSSIFIED CHRISTMAS CAROL* 113

APPENDIX B: TRENDS IN PERFORMING ARTS ATTENDANCE 119

APPENDIX C: DESIGN SKETCHES AND WORKS IN PROGRESS 121

APPENDIX D: GROUND PLANS, SECTION VIEWS AND ELEVATIONS 128

APPENDIX E: DEEPFAKE TECHNOLOGY EFFECTS ON PERFORMERS' FACES 136

APPENDIX F: PROJECTION DESIGN SKETCHES AND RENDERED IMAGES 138

APPENDIX G: PERFORMANCE IMAGES 142

APPENDIX H: OFFICIAL POSTER FOR *A SEUSSIFIED CHRISTMAS CAROL* 149

List of Tables

TABLE 1: SPECIAL EFFECTS EQUIPMENT 113

TABLE 2: PROJECTION IMAGES CUES 114

TABLE 3: KEY PRODUCTION TIMELINE FOR *A SEUSSIFIED CHRISTMAS CAROL* 117

TABLE 4: ESTIMATED AND ACTUAL COSTS FOR *A SEUSSIFIED CHRISTMAS CAROL* 118

List of Figures

FIG.1.1. DIMAGGIO, PAUL, AND TOQIR MUKHTAR. ***PLAY, MUSICAL, AND OPERA ATTENDANCE RATES IN THE UNITED STATES (1982-2002)*****. POETICS, 2004..... 119**

FIG.1.2. "U.S. TRENDS IN ARTS ATTENDANCE AND LITERARY READING: 2002-2017." ***THE UNITED STATES TRENDS IN PLAY, MUSICAL, AND OPERA ATTENDANCE.*** **NATIONAL ENDOWMENT FOR THE ARTS. 120**

FIG. 2.1. AUTHOR'S COLLECTION. ***MOOD BOARD.*** **2023. ..... 121**

FIG. 2.2. BARTON, JIM. ***A TRADITIONAL IRON SEAT DATED 1897*****. GEOGRAPH, 2011. ..... 122**

FIG. 2.3. AUTHOR'S COLLECTION. ***SEUSSIAN BENCH DESIGN INSPIRED 19TH CENTURY VICTORIAN STYLE.*** **2023..... 122**

FIG. 2.4. AUTHOR'S COLLECTION. ***PRELIMINARY SET SKETCHES.*** **2023..... 123**

FIG. 2.5. AUTHOR'S COLLECTION. ***PHYSICAL MODEL.*** **2023. ..... 124**

FIG. 2.6. AUTHOR'S COLLECTION. ***PHYSICAL MODEL.*** **2023. ..... 125**

FIG. 2.7. AUTHOR'S COLLECTION. ***PHYSICAL MODEL.*** **2023. ..... 126**

FIG. 2.8. AUTHOR'S COLLECTION. ***PAINTED PANELS.*** **2023..... 127**

FIG. 3.1. AUTHOR'S COLLECTION. ***GROUND PLAN.*** **2023. ..... 128**

FIG. 3.2. AUTHOR'S COLLECTION. ***SECTION VIEW.*** **2023. ..... 129**

FIG. 3.3. AUTHOR'S COLLECTION. ***PROJECTORS' LOCATION.*** **2023. ..... 130**

FIG. 3.4. AUTHOR'S COLLECTION. ***PROJECTORS' LOCATION.*** **2023. ..... 131**

FIG. 3.5. AUTHOR'S COLLECTION. ***PLATFORMS ELEVATION.*** **2023..... 132**

FIG. 3.6. AUTHOR'S COLLECTION. ***SCREEN AND STRING LIGHTS ELEVATION*****. 2023. ..... 133**

FIG. 3.7. AUTHOR'S COLLECTION. ***PROPS ELEVATION*****. 2023. ..... 134**

FIG. 3.8. AUTHOR'S COLLECTION. ***PAINT ELEVATION*****. 2023. ..... 135**

FIG. 4.1. AUTHOR'S COLLECTION. *THE GHOST OF CHRISTMAS PAST DEEPFAKE TEST USING DEEPFACELAB SOFTWARE.* 2023. 136

FIG. 4.2 AUTHOR'S COLLECTION. *MARLY'S DEEPFAKE TEST USING DEEPFACELAB SOFTWARE.* 2023. 137

FIG. 5.1. AUTHOR'S COLLECTION. *PROJECTION DESIGN SKETCHES*. 2023. 138

FIG. 5.2. AUTHOR'S COLLECTION. *SCROOGE'S ROOM PROJECTION DESIGN*. 2023. 139

FIG. 5.3. AUTHOR'S COLLECTION. *COUNTRY LANE PROJECTION DESIGN*. 2023..... 139

FIG. 5.4. AUTHOR'S COLLECTION. SEA PROJECTION DESIGN. 2023. 140

FIG. 5.5. AUTHOR'S COLLECTION. *FRED'S ROOM PROJECTION DESIGN*. 2023. 140

FIG. 5.6. AUTHOR'S COLLECTION. *GRAVEYARD PROJECTION DESIGN*. 2023. 141

FIG. 6.1. AUTHOR'S COLLECTION. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 142

FIG. 6.2. AUTHOR'S COLLECTION. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 142

FIG. 6.3. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 143

FIG. 6.4. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 143

FIG. 6.5. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 144

FIG. 6.6. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 144

FIG. 6.7. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 145

FIG. 6.8. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 145

FIG. 6.9. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 146

FIG. 6.10. SIMON, ANGELINE. *PANNING SCENE*. ARCHIVAL PHOTO, 2023. 146

FIG. 6.11. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 147

FIG. 6.12. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 147

FIG. 6.13. SIMON, ANGELINE. *A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 148

FIG. 6.14. HILLARD, SARAH. *POSTER FOR A SEUSSIFIED CHRISTMAS CAROL*. ARCHIVAL PHOTO, 2023. 149

List of Abbreviations

AI (Artificial Intelligence): Refers to the simulation of human intelligence in machines programmed to think and act like humans.

VR (Virtual Reality): A simulated experience that can be similar to or completely different from the real world, often used for entertainment or education.

NEA (National Endowment for the Arts): A U.S. government agency that offers support and funding for projects exhibiting artistic excellence.

LED (Light Emitting Diode): A semiconductor device that emits light when electric current passes through it.

Deepfake Technology: Involves the use of artificial intelligence to create or alter video and audio recordings to convincingly depict someone doing or saying things that they did not actually do or say.

DVFX: Digital Visual Effects, a process that integrates computer-generated imagery (CGI) into live-action footage to create realistic visual elements and environments that are not possible to capture on film.

3D Scanning: A technique used to digitally capture the shape of a physical object or environment using laser or structured light technology to create a precise 3D digital model.

3D Modelling: The process of creating a mathematical representation of a three-dimensional object or surface using specialized software, which can be used for various applications, including animation, simulation, and design.

Green Screen: A green backdrop used in video production that allows for digital manipulation of the background during post-production.

Holofan projectorss: Refers to projectors that use rotating blades equipped with LEDs to display holographic images.

Qlab: A software used in theatre to coordinate sound and video playback to precise cues.

Cue: In theatre, a signal for something to happen, used in the context of starting video or sound in synchronization with live performance.

Pre-production: The phase in theatre production that occurs before rehearsal begins.

Projection Screens: Surfaces where videos, images, or data are projected, commonly used in theatre to enhance visual storytelling.

Cyc (Cyclorama): A large cyclorama screen used at the upstage for projecting background visuals that complement the play's setting.

Snow Bag: Used to simulate snowfall on stage.

DS (Downstage): This refers to the area of the stage closest to the audience.

US (Upstage): The area of the stage furthest from the audience.

CS (Center Stage): The central area of the stage, equidistant from the left and right sides of the stage.

Chapter 1: Introduction

Theatre has long been celebrated for its unique ability to deliver immediate and immersive experiences, fostering a profound connection between performers and audiences. As one of the oldest art forms, theatre has consistently reflected societal changes and played a significant role in cultural and social landscapes. However, in recent years, declining audience attendance has threatened the sustainability and vitality of theatre.

According to a recent survey by the National Endowment for the Arts (NEA), published on October 19, 2023, only 48% of American adults attended at least one in-person arts event between July 2021 and July 2022, compared to 54% in 2017. Additionally, 82% of respondents engaged with arts activities through digital media during the same period, indicating a growing preference for alternative entertainment forms (NEA, "New Data").

This shift toward digital engagement highlights the challenge live theatre faces in retaining its audience amidst a rapidly evolving entertainment landscape. Live theatre refers to performances presented in front of a physically present audience in a theatre venue. The term "live" is used to emphasize its distinction from online or streamed theatre.

Given these challenges, exploring innovative strategies to revitalize live theatre is essential.This thesis investigates how emerging technologies can enhance live performances and make them more engaging for contemporary audiences. By examining empirical and theoretical evidence, the research aims to determine whether integrating live theatre with emerging technologies can create new opportunities and innovations to rejuvenate live theatre and draw modern audiences back to the stage.

1.1 Problem Statement

With all its allure and capabilities, the digital age has presented significant challenges for traditional arts such as theatre. In recent decades, theatre audiences have notably declined across various populations and regions, creating a widespread challenge for the performing arts. Numerous reports highlight this reduction. Examining the past 40 years (1982-2023), DiMaggio and Mukhtar's analysis of the Survey of Public Participation in the Arts (SPPA) from 1982 to 2002, which reveals significant changes in attendance trends in the United States. Their findings indicate a decrease in audiences for traditional performing arts, including theatre, particularly among younger people during this period (DiMaggio and Mukhtar). Attendance figures by age group support these observations (Fig. 1.1).

Subsequent data from the National Endowment for the Arts (NEA) underscores this trend, showing a significant decline in theatre attendance from 2002 to 2017, especially for non-musical plays (Fig. 1.2). In 2017, 22.9 million American adults attended non-musical plays, representing 9.4% of the adult population, down from 12.3% in 2002. Attendance dropped to 9.4% in 2008 and to 8.3% in 2012 before slightly recovering to 9.4% in 2017. Musical plays and operas also experienced declines during this period, with attendance numbers decreasing alongside those of non-musical plays. (NEA," U.S. Trends in Arts Attendance ").

Several factors contribute to this decline, including economic recessions, people's limited free time, and the costs associated with attending arts events. However, one primary factor was increased competition from home entertainment. Advances in home entertainment technology made staying at home more appealing. The internet, cable television, and other digital media provided convenient, accessible, and affordable alternatives, which many preferred over attending live theatre (DiMaggio and Mukhtar).

The situation was further exacerbated in 2020, when the COVID-19 pandemic profoundly impacted the digitalization of daily life worldwide, accelerating the development of digital entertainment. With real-world entertainment severely limited by safety measures, theatres had to close, cancel events, and limit audiences with stringent health protocols like social distancing and vaccination checks. As a result, audience numbers plummeted, while home and digital entertainment providers thrived, significantly increasing their customer base and demand for new services.

Statistics from various regions corroborate these trends. Statistics Canada shows that the pandemic led to a significant increase in internet use for entertainment purposes in Canada. Canadians, like many worldwide, turned to streaming services, video conferencing, and other online activities to stay connected and entertained. Nearly 50% of Canadians reported watching more streamed video content during the pandemic (Bilodeau et al.).

Similarly, in the United States, online consumption of arts and entertainment significantly increased. According to the National Endowment for the Arts, 75% of adults engaged with the arts through digital or electronic media, including watching videos, performances, and music concerts online. Many arts organizations provided free online content to maintain connections with their audiences during shutdowns (NEA, "Online Audiences for Arts Programming").

By the end of 2020, the performing arts sector was facing an unprecedented crisis. Both theatres and performers around the world faced immense challenges, with many struggling to survive because of extended closures and severe restrictions on live performances. For example, in the UK, the sector lost over 90% of ticket sales revenue, and in the United States, 27% of performers were unemployed in the last quarter of 2020, compared to just 1.1% in 2019 (Rooney).

Even after theatres reopened in 2020, many audience members did not return. This trend is attributed to various factors, including the preference for digital entertainment that many people had become accustomed to during the pandemic. These changes in audience preferences have made it challenging for theatres to recover their attendance levels to even pre-pandemic figures.

According to Teresa Eyring, executive director of Theatre Communications Group in the United States, theatres are facing a compounded crisis. Three years after the onset of the COVID-19 pandemic, theatres still struggle with significant challenges in attracting audiences back to their seats. The initial impact of the pandemic saw an 88% drop in ticket income within a year. Despite federal relief funds providing temporary respite, their end has left theatres struggling with inflation, staff burnout, and various operational challenges. Additionally, theatres contend with shifts in audience behavior, including a growing preference for digital and streaming entertainment, posing a new challenge in bringing people back to live performances ("Three Years After Pandemic").

This global decline in theatre attendance has led to significant challenges for theatres. Many have been forced to reduce the number of shows, cut down on actors, and shorten performance durations because of falling ticket sales. For example, in 2023, the Grand Theatre in Calgary, Canada, nearly lost its space because of financial difficulties. Theatre artists across the globe have also struggled with unemployment and fewer job opportunities. As costs rise and revenues decline, many theatres have had to lay off staff or combine job roles. The Prairie Theatre Exchange in Winnipeg, Manitoba, Canada, for instance, reduced or consolidated seven positions for the 2024 season (O'Kane and Nestruck). These trends highlight the pressing challenges facing the theatre industry and underscore the need for meaningful solutions.

Addressing the decline in live theatre attendance, which has been driven by changes in audience behavior and a growing preference for digital and streaming entertainment, might involve exploring innovative strategies to enhance the live experience, potentially attracting audiences back to live performances and preserving the art form for future generations.

1.2 Thesis Objectives

This paper's primary goal is to introduce and examine emerging technologies and their applications in theatre to foster innovative and extensive use of these technologies, thereby facilitating the attraction of more audiences to live theatre. It also explores the new possibilities these technologies provide to theatre art. This thesis demonstrates how these technologies can expand the traditional boundaries and visual and artistic capabilities of theatre and enhance storytelling, ultimately leading to a deeper and more immersive experience.

Overall, to better understand these issues, this thesis is written in response to the following questions:

1. What emerging technologies can be utilized in theatre, and what new possibilities do they offer? Additionally, what are the limitations and challenges associated with these technologies?
2. Do these technologies enhance the audience experience and the quality of theatrical productions?
3. Does the utilization of emerging technologies lead to attracting more audiences?
4. How might emerging technologies shape the future of live theatre?

1.3 Practical Project Introduction

For my practical project, I designed the set and props for Peter Bloedel's *A Seussified Christmas Carol*, performed from October 11–14, 2023, at the University of Lethbridge Theatre, directed by Ryan Reese.

Since my thesis explores emerging technologies to enhance theatre experiences and attract larger audiences, I designed this project in such a way that, using Deepfake technology, the faces of the actors portraying two of the ghost characters in *A Seussified Christmas Carol* replaced with the faces of two iconic actors, Danny DeVito and Elvis Presley, and these actors, using hologram technology, appeared digitally and three-dimensionally in a realistic manner on the theatre stage and interacted with the live actors. To increase visual appeal and expand the world of the play, I designed digital backdrops in each scene, designing and animating their content to match the theme and style of the play (Fig. 6.3- 6.5). My goal was that with the help of these technologies, the presence of these two actors on the theatre stage would be believable, creating the illusion that the original famous actors are present on the stage and performing.

My hypothesis was that a diverse audience would be attracted to this play, knowing that famous actors from the past and present were performing in it. I believed awareness of these actors' presence could pique the audience's curiosity and encourage attendance. The reappearance of a long-deceased actor on stage could create a memorable experience for audiences. Additionally, fans of these actors would come to see the play out of their interest in their favourite artists.

Furthermore, I hypothesized that using emerging technologies would offer the audience a unique experience, potentially drawing them to the theatre to enjoy a new experience that might not be possible in traditional theatre. For instance, the magical presence of the ghost character

through hologram technology could provide an engaging and different experience, enhancing the audience's overall experience.

While these technologies may have been previously explored in theatre around the world, this project aimed to use these modern technologies innovatively, incorporating creative ideas to inspire future theatre practitioners. The goal was to produce distinctive performances with the help of emerging technologies, attracting a wider audience and thereby increasing theatre attendance.

1.4 Thesis Structure

This thesis begins by examining the development and impact of digital and online theatre, exploring how these advancements have shaped audience engagement and participation. It includes an analysis of the historical transition from live performances to recorded and online formats, showcasing the resulting changes in audience behaviour and theatre economics. This section also addresses the challenges of digital theatre, particularly in comparison to traditional live theatre regarding presence and communal experience. Additionally, this thesis analyzes the perspectives of both critics and proponents on the use of digital technologies in theatre, examining their influence on the balance between innovation and tradition. This thesis then provides a brief history of theatre and its technological evolution, emphasizing key milestones that have influenced live performances.

A subsequent section introduces and examines emerging technologies in live performances worldwide. This section explores how these technologies work, their limitations and challenges, and their impact on the theatre audience experience.

The thesis then outlines the practical project, detailing its proposed ideas and hypotheses, as well as the design of staging and projection for the performance. It also examines the challenges and solutions encountered during the project and provides recommendations for integrating emerging technologies into future theatre productions.

Chapter 2: Online Theatre

The digital age has fostered a culture of 'on-demand' entertainment, where audiences expect instant access to content across various digital platforms. Today, most Americans under the age of 30 are accustomed to experiencing the arts not in public performance venues, but whenever and wherever they want, with the click of a button on their devices (Teachout). The expansion of digital entertainment has undeniably impacted traditional forms of live performance, including theatre, and is considered a major factor in the decline of live theatre audiences. However, instead of succumbing to these challenges, theatres have taken significant steps to adapt and evolve alongside technological advancements. By utilizing the digital world, they have maintained their connection with audiences and, in some cases, even attracted new viewers.

In the late 19th century, the recording of theatre performances began with the advent of film, video, and digital technologies, marking the start of a significant shift in how theatrical productions were preserved and experienced. This shift toward "mediated theatre," where live performances are recorded and distributed through various media, was a response to the changing needs of audiences and a way to preserve and study theatrical performances beyond live viewing (Bay-Cheng, “Digital Performance").

With the continued advancement of technology, the role of recorded and mediated theatre became increasingly prominent. By the early 2000s, the impact of these changes was evident: the 2002 National Endowment for the Arts (NEA) Survey of Public Participation in the Arts (SPPA) showed near parity between attendance at live theatre performances and the viewing of recorded performances. While 22.3 percent of adults had attended at least one live theatre performance in the previous year, 21 percent had watched at least one recorded version of a theatre performance.

This near-equal number was even more striking when considering the frequency of viewing: adults who attended at least one live theatrical performance were found to have watched twice as many recorded productions of musicals and three times as many non-musical productions (Bay-Cheng, "Theatre Squared"). This statistic highlighted the significant role of digital media in people's lives and the entertainment preferences of audiences at that time.

Therefore, theatre companies around the world began making significant investments in digital programming, recognizing the potential to reach audiences who might prefer digital access. Initiatives such as the Berliner Philharmoniker's Digital Concert Hall and the Metropolitan Opera's *The Met: Live in HD* live-stream series, both launched in the late 2000s, set standards for live streaming theatre and opera, making high-quality performances accessible to global audiences (Hawthorne). Additionally, the National Theatre in the UK followed with its *National Theatre Live* (NTL) initiative in 2009, which broadcast live performances to cinemas worldwide, extending the reach of theatre beyond traditional venues (Wallisch).

These digital platforms made the theatre experience more accessible and immersive, while also blending various forms of theatre and film to create a new form of art. Through the use of camera techniques, different perspectives of the stage, such as close-ups and medium shots, became available to audiences. These views, which live theatregoers might not experience, enriched the storytelling process (Jiang and Alizadeh).

The COVID-19 pandemic accelerated the adoption of digital theatre. With physical venues closing, many live theatres turned to online platforms to maintain audience engagement. This period saw a significant boom in digital theatre productions. A study conducted by the European Theatre Convention (ETC) and the Academy for Theatre and Digitisation in Dortmund showed that ticket sales for digital performances in Europe increased by 772% from 2019 to 2021

(Hawthorne), While ticket sales for live theatre plummeted, reaching their lowest levels since World War II, many theatre companies began embracing digital programming as a long-term solution, shaping the future of theatrical performance ("COVID-19: Impact on the Theatre Industry").

During the pandemic, digital theatres explored new ways of creative expression and audience engagement. For example, the National Kaunas Drama Theatre (NKDT) in Lithuania launched an online platform called Theatre Onl1ne TV, which allowed performances to be presented digitally and interactively to audiences. This online platform showcased plays and children's shows, enabling comments and discussions through platforms like Zoom and Facebook during performances, thus facilitating direct interaction with the audience in online performances (Pukelyte).

In recent years, as theatres navigate the post-pandemic landscape, many believe that digital programming will continue to play an important role in their strategies to attract audiences. Many theatres are investing in digital platforms and exploring new technologies with the aim of reaching a wider audience and creating innovative experiences that resonate with the desires of contemporary viewers ("Three Years After Pandemic")

For example, today, virtual reality (VR) technology enables audiences to experience a theatrical setting through immersive 3D or 360-degree environments using VR headsets. This enables viewers to fully immerse themselves in virtual environments (He et al.). This technology blends theatre with virtual gaming, transforming audiences from passive spectators into active participants. Viewers can interact with various elements of the performance and even alter the storyline, creating a new, dynamic form of theatrical art (Pike, “Virtually Relevant”).

One example of VR theatre experience can be seen in the productions of MWM Immersive, a company based in the United States. MWM Immersive's *Chained: A Victorian Nightmare* is an immersive location-based VR theatre experience based on the classic novel *A Christmas Carol.* In *Chained*, one audience member at a time is guided through the world of the performance while wearing a VR headset. Using motion capture suits, actors interact with the audience in real time, although the audience sees virtual renditions of the play's characters. VR technology has also progressed in the evolution of online theatre, offering endless possibilities for recorded and online theatrical experiences. For example, this technology is used for streaming performances by the UK-based company LIVR. LIVR, marketed as the world's "first on-demand VR theatre platform," hosts professional recordings of theatre performances that audiences can experience at any time. Unlike live VR performances, LIVR provides access to recorded past productions rather than real-time shows. However, its mission remains the same, to "make theatre more accessible to everyone" by offering a 'fully immersive 360-degree experience' that allows audiences to enjoy professional theatre from the comfort of their homes (Wallisch).

2.1 Challenges of Online Theatre

As a modern innovation in the performing arts, digital and online theatre has achieved remarkable milestones. From providing access to performances for global audiences to offering new and diverse experiences, this form of theatre has succeeded in breaking down geographical barriers and creating fresh opportunities for artists. However, despite these advantages, digital theatre also presents challenges and drawbacks that cannot be overlooked. In fact, when we examine the fundamental differences between these two forms of theatre, it becomes clear that, despite its unique capabilities, digital theatre has not yet been able to fully replace the authentic and singular experience of live theatre.

One of the most significant challenges of digital theatre is the loss of the sense of presence and embodied connection that is strongly felt in live theatre. In live performances, the audience is not only engaged visually and audibly, but the physical presence in the theatre, interaction with other audience members, and the collective emotions that arise during the performance create a unique and immersive experience. In contrast, online theatre lacks this deep connection due to the physical separation between the audience and performers and its reliance on digital platforms. In other words, the audience in digital theatre often becomes a passive observer rather than an active participant who engages in the live performance (Vandenbroucke and Meeks).

Even when interaction is facilitated through platforms like Zoom or Facebook, distractions from the surrounding environment, the audience's inability to focus because of attempts to communicate by typing, or the discomfort of being seen through a computer camera, all while trying to manage their reactions, along with technical and technological issues like unstable internet connections, significantly affect the online theatre experience and prevent it from matching the overall experience of live theatre (Jiang and Alizadeh). These issues can also directly impact the quality of the actors' performances.

The heart of live theatre is in its immediacy and the emotional bond it creates between performers and the audience. This real-time connection and the energy of a live show are hard to replicate in an online setting. Erika Fischer-Lichte, a German theatre scholar, highlights the importance of live performance, stating that the physical presence and direct interaction between actors and audiences are key to the theatre experience. She points out that the audience plays a vital role, with their mutual, immediate response creating a shared and deep experience that is central to live theatre (qtd. in Bay-Cheng 18). This special, shared experience sets live theatre

apart from digital versions and shows its lasting importance. Live theatre also brings people together to share emotions in a common space, building a sense of "communitas" or social bonding. Digital theatre, on the other hand, reduces this experience to watching alone at home, taking away the social aspect that makes live theatre appealing. This change not only impacts how theatre is enjoyed but also weakens the sense of community and cultural connection that theatre helps build (Muzychuk).

From an artistic perspective, digital theatre also faces unique challenges. A major concern is the potential diminishing of the artistic and professional value of performances. When theatre is presented online, it may be perceived as just another piece of content among the vast array of other online media, losing the unique and ephemeral value inherent in live performances. This concern is heightened when online theatre is presented alongside amateur and non-artistic content, further eroding its perceived worth (Timplalexi). As a result, this issue could pose a serious threat to the future of theatre, as the boundaries between high art and everyday online content become increasingly blurred, potentially weakening the demand for live theatre.

Ultimately, one of the serious concerns about digital theatre is its negative impact on the theatre economy. Although tickets for online theatre are often priced lower than those for live performances, many audiences are reluctant to pay for online shows, as most online entertainment content is nearly free for viewers. This has created significant challenges for theatres in securing the necessary funding (COVID-19: Impact on the Theatre Industry).

Moreover, online theatre may lead to the loss of cultural institutions and a decline in social interactions within local communities, a concern that is particularly critical in smaller and rural areas that rely heavily on the presence of live theatre (Muzychuk).

In conclusion, while digital theatre has introduced valuable innovations and provided new possibilities, it still cannot replace the rich and unique experience of live theatre. Despite its advantages, digital theatre has its limitations and drawbacks, and in some cases, it may even pose a threat to live theatre. To preserve theatre's artistic, cultural, and social value, it is essential to acknowledge these challenges and develop strategies to sustain the live theatre experience.

2.2 The Taste of Today's Audience

Understanding contemporary audience preferences is crucial for attracting them to live theatre. Modern audiences, influenced by daily interactions with social media and digital platforms, have developed new expectations for entertainment. These platforms offer high-quality content, complex animations, and striking special effects, setting a new standard for visual storytelling, one that increasingly influences audience expectations across all entertainment forms, including theatre.

According to Hasrul Hashim, the film industry's transition from analogue to digital technology has rapidly transformed the industry, particularly in the use of digital visual effects (DVFX). Films incorporating these effects have created a demand among audiences for technological innovation. Initially, digital visual effects were used primarily to correct or enhance flawed elements during post-production, but they have since played a crucial role in reshaping audience tastes in 21st-century cinema (Hashim 183).

The entertainment industry is more focused than ever on creating content enhancing visual experiences. The advancements in DVFX technology have not only improved the quality of visual representations but also elevated audience satisfaction (Hashim 190). This shift suggests that audiences now anticipate similar levels of technological innovation and visual engagement in live theatre. Consequently, it is important to consider how these evolving tastes and expectations

might influence audience engagement with live theatre. By integrating technological advancements, theatres can develop immersive experiences that resonate with contemporary audiences.

2.3 Proponents' and Critics' Opinions

The evolving tastes and expectations of today's audiences have sparked a debate among proponents and critics regarding the integration of emerging technologies in theatre. While some audiences have come to expect high-quality visual effects and technological innovations, critics argue that special effects in theatre risk overshadowing the play's literary depth and the actors' performances. They contend that technology in theatre should enhance rather than alter its fundamental artistic essence or disrupt its traditional storytelling methods (Baugh 6).

Conversely, proponents of digital theatre and technology claim that the use of technology and artistic creativity can be balanced to prevent the story from being overshadowed by the decor of new media in some performances (Kuksa and Childs). In fact, tools such as video, motion, 3D glasses, lighting and sound designs, as well as audio-visual mixes and montages are employed to address the shortcomings and limitations that verbal narration and dialogue face in some performances, thereby creating a more complete connection with the audience.

Critics believe that in the fast-paced, artificial noise of today's virtual world, humans need moments of reflection, tranquillity, and respite from haste more than anything else to gain reassurance and peace by staying away from the virtual environment (Delago and Svich).

On the other hand, a prominent theory among digital theatre advocates is that, because of rapid technological advancements, theatre must adapt by incorporating technological innovations

to remain relevant and viable in the future. Therefore, if it wants to attract today's diverse audience, it must equip itself with the language of contemporary media.

In this regard, Matthew Casey, a Drama professor at Trinity College Dublin, argues in *Theatre in Crisis?* that theatre must embrace new technologies to meet the needs of modern audiences and align with the ever-evolving media culture. He believes that theatre should act as a cultural laboratory where new forms of performance are created, and digital tools can provide a hybrid and mediated experience in live performances (qtd. in Delgado and Svich 179).

Supporting this viewpoint, a report by AEA Consulting for Arts Council England highlights that technology in theatre can balance leveraging new opportunities presented by innovations and preserving the essence of traditional live performance. The report emphasizes that digital theatre does not replace traditional live theatre but rather complements it. By coexisting, both forms can broaden their reach, engage diverse audiences, and contribute to the cultural enrichment of society (AEA Consulting).

2.4 The History of Technology in Theatre

Technology has long been a driving force in the evolution of theatre, enhancing both its artistic quality and audience appeal. From its inception, theatre has been influenced by the technologies of its time, striving to surpass the capabilities of ordinary life and create a distinctive and impactful image on stage. Often, these technologies were used as tools to realize challenging scenes, such as explosions, disasters, and atmospheric effects. However, sometimes, technologies themselves became turning points in the performance experience, astonishing audiences with their operation.

In ancient Greece, theatres used mechanical devices like the "mechane," a crane that allowed characters to appear as if they were flying, often representing gods or spirits. This device became more common in the later fifth century and was frequently used by the dramatist Euripides. For example, in his play *Bellerophon*, the character Bellerophon flew on the winged horse Pegasus, while in *The Madness of Heracles*, the goddesses Iris and Lyssa descended from the sky in a chariot. Although the mechane was large and difficult to operate, it played an important role in enhancing the spectacle of ancient Greek theatre and inspired the development of more advanced stage machinery (Arnott 26). During the Renaissance, technology was used in performances to symbolize political power and control. Hidden mechanisms, like elevators, allowed royals and dukes to miraculously appear on stage, reinforcing their authority. Similar displays of technological spectacle were seen in religious and operatic performances, such as the *angels suspended* in Filippo Brunelleschi's duomo in Florence and the *mythic river maidens* in Wagner's operas. These performances used advanced stagecraft to present rulers as divine or supernatural figures, strengthening the link between technology, spectacle, and political power (Baugh 2).

Building on early innovations, the 19th-century introduction of gas lighting marked a significant advancement in theatre, replacing candles and oil lamps and greatly enhancing safety and visual capabilities. Notably, the limelight, a bright, focused white light, became famous for spotlighting actors or specific actions on stage. The first use of limelight in theatre occurred on December 26, 1837, at the Theatre Royal at Covent Garden in London, under the management of William Charles Macready, a prominent English actor and theatre manager. This marked the beginning of modern stage lighting. Limelight was the first practical spotlight used in theatre, laying the foundation for modern lighting theory and practice (Goodman).

As the late 19th century ushered in new technologies, electric power and lighting dramatically transformed theatrical productions. The Savoy Theatre in London, for example, became the first theatre fully illuminated by electricity in 1881, marking a significant departure from gas lighting. This advancement allowed for enhanced precision in lighting effects, which improved the audience's experience by providing clearer visibility of the actors and scenery. Additionally, electric lighting, as demonstrated at the Savoy with Joseph Wilson Swan's newly perfected electric bulbs, reduced the fire hazards associated with gas lamps, contributing to the safety of theatres (McWilliam 2). This period also saw the gradual replacement of hydraulic-powered scenery manipulation with electric motors, making complex scenic maneuvers like lifting, lowering, and sliding more precise and reliable (Baugh). These innovations in electric power not only enhanced the visual spectacle but also added to the overall efficiency and safety of theatrical productions.

The arrival of cinema in the late 19th century had a profound impact on theatre, reshaping the way stories were told on stage. As silent films, and later sound films, began to incorporate cinematic techniques into live performances, the foundation for what we now call digital theatre was laid (Tajtáková). This modern approach marries traditional theatrical elements with digital technologies, like multimedia projections, allowing new media to become part of the live experience. One of the earliest examples of integrating film into theatre was Winsor McCay's 1914 performance with *Gertie the Dinosaur*, where McCay interacted with an animated character projected on a screen. McCay's precise timing allowed for the illusion of Gertie responding to his commands, blending live performance with film in a way that prefigured the use of multimedia projections in modern digital theatre (Dixon and Smith73).

From the 1970s to the end of the 20th century, media projections in theatre, dance, and performance art proliferated. The relative inexpensiveness, immediacy, and ease of use of video technology led many artists and groups to integrate visual media within their live performances. A notable example from this period is The Wooster Group, known for integrating video and film into their experimental works, such as *Route 1 & 9* (1981). Their productions often challenged traditional theatrical forms by blending multimedia with live action, creating fragmented, non-linear narratives that emphasized visual and auditory experiences (Dixon and Smith).

During the early 20th century, sound technologies gradually entered theatre and had a profound impact on live performances. While earlier theatres relied on mechanical tools like thunder sheets and wind machines for sound effects, the post-World War II era saw a revolution in sound technology with the advent of recording and amplification systems. A pivotal early use of recorded sound in theatre occurred in 1890 when Colonel Gouraud played a recording of a baby crying during a performance, showcasing the potential of sound technology in live productions (Hendriks). By the 1950s, the use of sound amplification systems and speakers, like the Ferrograph magnetic tape recorder, which allowed for high-quality sound recording and playback, became widespread in theatre. This technology enabled precise amplification of actors' voices and sound effects (Baugh).

The 21st century has ushered in an era where theatre's evolution is increasingly shaped by rapid digital innovation. The integration of digital projections, sound design, and interactive media has transformed not only the aesthetic experience but also the technical possibilities of live performances. This development paved the way for a new era of experimentation, one in which emerging technologies are now at the forefront of theatrical innovation. With the potential to further reshape audience engagement and artistic expression, technologies such as Virtual Reality

(VR), Augmented Reality (AR), and artificial intelligence (AI) represent the latest stage in this historical progression.

The next section will explore how these emerging technologies are not just expanding the possibilities of live performance but also redefining the very nature of audience engagement and artistic expression.

2.5 Emerging Technologies

The potential of emerging technologies to revolutionize live theatre is a compelling area of exploration. Technologies such as Virtual Reality (VR) and Augmented Reality (AR) are increasingly being explored in theatre productions, though their adoption remains in its early stages. These technologies, along with innovations like holographic projections and artificial intelligence (AI), offer the promise of creating unique and immersive experiences that can deepen audience engagement and enhance artistic expression.

The integration of these technologies, however, is not without its challenges. There are concerns that incorporating digital elements may compromise the authenticity and intimacy that define live theatre. Additionally, the high costs and accessibility issues associated with these technologies pose significant barriers. As mentioned in the critics' opinion section, there is also the risk that the technological aspects could overshadow the narrative and the actors' performances, potentially detracting from the core essence of the theatrical experience.

Despite these challenges, the capabilities of emerging technologies to complement traditional theatrical techniques cannot be overlooked. Historically, innovations in lighting and sound design have expanded the expressive possibilities of theatre, deepening audience immersion and engagement. The current wave of technological advancements holds similar

potential, but striking a balance between innovation and the intrinsic value of live performance remains essential.

In the following sections, I will delve into some of the latest technologies applicable to live performances, evaluating their limitations and challenges and their overall impact on the quality of performances and audience experience. By examining performances that have successfully integrated these new technologies, I aim to understand their practical applications and effects. This analysis will explore how these technologies can be effectively incorporated into theatre, drawing insights from existing productions to inspire further innovation, an approach that also informed my selection of technologies for my thesis project.

2.5.1 AR In Theatre

Augmented Reality (AR) represents a significant advancement in emerging technologies. It offers a blend of the real world with three-dimensional objects generated by computers. This integration merges digital and physical elements, transforming how audiences perceive and engage with theatrical storytelling. Unlike traditional theatre, which relies on the audience's imagination to fill in the gaps in the presented story, AR creates an external world that immerses the audience in the creator's imagination (Pike, “Make it so…”).

Essentially, AR technology operates through the overlay of digital content in the real world. AR integrates digital images directly into the user's environment in real-time, improving interaction and content comprehension. This is achieved through sophisticated computer vision techniques and image registration processes that ensure virtual objects are fully aligned with the physical environment, as seen through AR devices. Creating AR objects involves techniques such as photogrammetry, which extracts precise 3D models from photographic data. Additionally, 3D

scanning and advanced modeling techniques generate highly accurate interactive elements that seamlessly integrate into the user's environment (Hussein et al.).

AR technology redefines the concept of user experience by offering immersive interactions that transcend the limitations of two-dimensional interfaces. Users equipped with AR devices, such as head-mounted displays, 3D glasses, smartphones, and tablets, can interact with virtual objects as if they are part of their immediate surroundings (Mendoza-Ramírez et al.). This direct interaction fosters a deeper engagement with content, making AR a valuable tool across various fields, including education, professional training, and live theatre.

One notable example of AR in theatre is the *Gulliver's Travels* show in Tel Aviv, Israel, which was performed in 2018. By integrating virtual images with live performances, the show provided the audience with a composite visual experience, requiring viewers to wear special glasses. This integration transformed traditional theatre by augmenting the stage's visual possibilities and storytelling. Virtual elements, such as oversized or fantastical creatures, seamlessly interacted with live actors, bringing imaginative scenarios to life (Xu and Zhang).

While the use of AR can enhance storytelling by adding elements that might be unfeasible to physically perform on stage, such as mythical creatures or special effects, it has drawbacks, particularly its dependency on the audience's use of smart devices, which may not be accessible to all attendees. This limitation could prevent some audience members from fully experiencing the show, potentially impacting the inclusivity and accessibility of theatre. Therefore, it is crucial to carefully consider the limitations and accessibility of the technology.

2.5.2 AI In Theatre

Artificial Intelligence (AI) is emerging as an innovative tool for enhancing audience engagement and expanding creative possibilities. AI creates new opportunities for interaction between the production and the audience, ranging from direct engagement to the live creation of creative content. Additionally, AI contributes to story development, set design, and even the automatic writing of music and poetry (Garcia). These innovations seek to deepen audience immersion and expand theatre's artistic scope.

For instance, the production *No Body Lives Here (ODO)* directed by Chris Ziegler and staged in Munich and Karlsruhe, Germany, represents one of these prominent innovations. In the play, the central character, ODO, is a fascinating example of the fusion of art and AI. Inspired by characters like The Little Prince and HAL9000 from *2001: A Space Odyssey*, ODO is an AI character trapped on stage and not connected to the internet. This feature allows ODO to gather information solely through direct interaction with the audience. Throughout the performance, ODO collects stories and experiences from the audiences, a process facilitated by advanced technologies in natural language processing and deep learning. ODO's AI enables him to speak in a language similar to humans or robots and also to create music and poetry that seems to be made by humans (Ziegler). This interaction helps ODO generate new content and serves as a bridge between human creativity and AI's computational power.

However, despite the vast potential of AI technology, integrating AI in theatre involves several challenges that may impact creative freedom and the authenticity of artistic expressions. AI relies heavily on extensive datasets derived from previous works, as it generates content by analyzing existing patterns. This approach may limit creative originality, resulting in outputs that are repetitive or formulaic, mirroring past trends instead of fostering new artistic directions.

Moreover, while AI can aid in content creation, it inherently lacks the human qualities of intuition and emotional depth, which are vital in the arts. This absence may lead to artistic works, such as scripts or music, that miss the nuanced understanding and emotional resonance typically imbued by human creators, resulting in creations that might seem mechanical and lack a genuine human touch. Addressing these challenges is crucial to maintaining the integrity and diversity of artistic works in theatre when utilizing AI technologies (Egon et al.).

2.5.3 Motion Capture

By leveraging advanced motion capture technology in live performances, the theatre industry has entered a new phase of innovation and digital art. Motion capture, originally used primarily in the film industry, is now a key tool in live theatres for controlling and performing virtual characters.

This technology accurately captures actors' movements and maps them onto digital avatars, enabling seamless interaction between virtual and live performers (Geigel and Schweppe 775). This capability to create advanced special effects undoubtedly provides a powerful tool for designers and directors.

However, motion capture requires specific equipment and software, which involves high costs for the theatre. Additionally, using this technology may require specialized training for actors and the technical team to effectively utilize it.

Actors wear specially-equipped suits with advanced sensors that track and translate their movements into digital animations. These suits employ different motion capture techniques, including optical systems with reflective markers and camera-less systems that transmit motion data directly to computers. This recorded data is processed in specialized software and mapped

onto three-dimensional models of virtual characters. This process ensures that the live movements of the actor are accurately represented as the movements of digital characters on stage (Geigel and Schweppe).

These characters are then displayed through projectors or digital screens, facilitating interaction between human actors and virtual characters, creating a completely new and engaging theatrical experience.

The Royal Shakespeare Company's 2016 production of *The Tempest* in the United Kingdom can be cited as an example that has utilized motion capture technology. In this production, an actor wearing a motion capture suit portrayed Ariel, with sensors tracking their every movement and mapping them onto a digital avatar. This digital avatar could perform superhuman actions, such as morphing its form or appearing in multiple locations simultaneously on stage. This technology allowed the actor to interact more extensively with other characters and create a stronger visual impact on stage (Lavender).

Beyond animating fantasy characters, motion capture also facilitates the creation of interactive virtual landscapes. Real-time motion capture generates dynamic digital landscapes that evolve in response to actors' movements and interactions. In a study conducted at the Hellenic Cosmos Cultural Center, motion capture data was transmitted live to Motion Builder software and displayed live in the background of the scene (Andreadis et al.). This approach creates an interactive experience for the audience, where environmental changes and landscapes dynamically shift based on the narrative of the play.

2.5.4 Screen Projections

Theatre projection screens enhance visual storytelling by integrating dynamic images and backgrounds, complementing physical sets and creating immersive environments. However, maintaining consistent image quality remains a challenge, as projectors must adapt to varying lighting conditions. Controlling ambient light levels is essential to preserve the clarity and brightness of the projected image.

Theatre projection technology typically employs video projectors and specialized software, using two main methods: front projection and rear projection. Front projection casts images directly onto the screen from the audience's side, but it can create shadows when performers or objects obstruct the light path. Rear projection, on the other hand, projects images from behind the screen, eliminating the issue of shadows and often resulting in sharper visuals (Summet et al.).

However, rear projection can be challenging due to its spatial and cost demands. Rear projection screens are typically made of more expensive materials that allow light to pass through while preserving high image quality. Since some brightness is reflected back toward the projector, a more powerful and more costly projector is often required to achieve sufficient image brightness (Adams). Additionally, rear projection requires a substantial area behind the screen for positioning the projector and providing the necessary throw distance. This setup may require significant remodeling or a sacrifice of stage or venue space, which further increases costs.

Today, laser projection systems represent some of the newest and most advanced projector technologies. Utilizing electronic, optical, and mechanical techniques, these systems deliver high-quality images with greater efficiency and durability than lamp-based projectors. These projectors provide images with high brightness and clarity on large scales, similar to cinema screens, and

are cost-competitive with other projection technologies. They offer modern capabilities such as 360-degree projection and 3D video, ideally suited for diverse uses in large environments (Clynick).

However, high-quality laser projectors can be costly to acquire and maintain, making them impractical for some theatre companies. Therefore, while laser projection technology offers many possibilities, weighing these costs against the benefits of its effective use in enhancing theatrical productions is essential.

Notable shows like *Dear Evan Hansen* and *Anastasia* on Broadway have effectively used projection design to add depth and emotional context to their theatrical presentations. These technologies function not merely as visual backgrounds but as active elements in the performance, interacting with actors and significantly impacting the stage atmosphere.

Aaron Rhyne's projection design in *Anastasia* is crucial for enhancing the audience's emotional connection to the story. His cinematic projections immerse viewers in the narrative, enhancing both the visual depth and emotional resonance of the performance. According to Margaret Gray in the *Los Angeles Times*, Rhyne's fluid scenes resemble hallucinations, transforming backdrops into vibrant eye candy, enhancing moments like a thrilling train ride without moving an inch. These projections take the audience on a journey through St. Petersburg, Eastern Europe, and Paris, making them feel physically and emotionally part of the story, showcasing technological prowess and immersive storytelling (Gray).

These visuals serve as a backdrop and actively contribute to the storytelling by reflecting the characters' internal and external journeys, enhancing the audience's emotional engagement (Grigware). In a review of the musical "Anastasia," Karen Bovard explains that the projections

conjure up ghostly figures when necessary, adding tones of nightmare and mystery. Aided by the triple turntable set designed by Alexander Dodge, the proscenium show's sheer array of looks is stunning. Bovard further notes, "I wager the visuals alone will keep even young audience members raised on movies fully captivated" (Bovard, par. 6).

In *Dear Evan Hansen*, Peter Nigrini's design of screen projection technology was crucial to the entire stage scenery. This intricate and comprehensive multi-screen projection system highlighted the impact of social media on daily life, creating an immersive social media environment for the actors. Nigrini explains:

> The cornerstone of the play is Evan's interaction with the real world through a social media lens. To successfully tell our story, social media needed to be a visceral part of the theatrical environment. After the set designer created a physical environment, my job was to bring this virtual world to life on stage and give it the emotional power that so many clearly feel in their day-to-day lives. (“Dear Evan Hansen”, par. 3)

Every surface of the playing space could be covered by content, from the front projection system and tracking panels to LCD monitors and the stage floor. Using eight projectors and 32 monitors, images were precisely displayed in various locations (“Dear Evan Hansen”).

Nigrini projected a cast of three dozen virtual characters on stage, constructing a social mediascape that conveyed the omnipresence of the internet and an individual's potential isolation within it. He emphasized that projection design was not just about decoration but about telling stories in new ways (Morgan).

2.5.5 Projection Mapping

Projection mapping in theatre employs innovative technology to create dynamic visual experiences. Using advanced software and hardware, this technique projects three-dimensional images and videos onto non-flat surfaces such as stage sets and props. This enables designers to create immersive and dynamic environments that interact directly with live performance elements.

Live projection mapping, particularly when applied to dynamic objects in the performing arts, offers a captivating visual experience that merges digital technology with traditional theatrical elements. This technique also allows for the projection of images or videos onto actors or their costumes, which may continuously move or change shape, thereby enhancing the narrative and visual impact of the performance. For instance, in the Korean musical *Turandot*, produced by the Daegu International Musical Festival, live projection dynamically changed the appearance of actors' costumes during performances, highlighting specific moments of the story and adding a layer of visual magic to the show (Lee et al.).

The operation of this technology involves the use of infrared cameras and powerful projectors to accurately track and project images onto moving targets. One advanced tracking device used for this purpose is the Microsoft Azure Kinect DK, a developer kit that includes a depth sensor, a spatial microphone array, a video camera, and an orientation sensor. It supports real-time body tracking and motion prediction, which is essential for integrating projected images with live actions (Baroya). The ability to project detailed textures and patterns onto dynamic objects live represents a significant advancement over traditional projection methods, usually limited to static backgrounds. Although projection mapping requires complex setup and design, ongoing advancements are making it increasingly vital to live performances (Pike, 'Make it

so…'). However, its effectiveness depends on suitable projection surfaces and controlled lighting conditions, as excessive ambient light can diminish image clarity.

2.5.6 Hologram Technology

Hologram technology has revolutionized theatre, concerts, and exhibitions by offering stunning visual effects and immersive experiences. Utilizing powerful projectors and transparent or semi-transparent surfaces, this technology displays three-dimensional images in space, allowing viewers to see these images without the need for special glasses. Holograms captivate audiences with their striking realism, creating unforgettable experiences.

One of the most famous examples of hologram use in concerts is the holographic performance of Tupac Shakur at the Coachella Music Festival in 2012. At this event, Tupac's hologram exhibited remarkably lifelike movement and vocal accuracy, creating the illusion of his presence on stage. This hologram, which interacted with Snoop Dogg, captivated the audience's attention. The hologram was produced by Digital Domain Media Group using advanced computer graphics and sound engineering techniques, accurately simulating details such as tattoos, jewelry, and body movements. The technology employed a modern variation of the Pepper's Ghost technique ("Coachella's Astonishing' Tupac Shakur Hologram").

Pepper's Ghost is an illusion technique from the mid-19th century, popularized by John Henry Pepper. It uses a sheet of glass or clear plastic film positioned at an angle to reflect an image of a hidden object or person, making it appear as part of the scene in front. Originally proposed by Henry Dircks in the 1850s, Pepper improved it with angled glass for better reflection. This creates a ghostly apparition that can interact with physical actors on stage (England).

When *Pepper's Ghost* debuted during a Christmas Eve performance of *The Haunted Man* at the Royal Polytechnic Institution in London in 1862, audiences were astounded by what they perceived as supernatural occurrences on stage. Many were convinced they were seeing actual ghosts, with the illusion generating such excitement that it quickly became a sensation throughout Victorian London. The Prince of Wales and his wife even attended a performance in 1863, so impressed by the spectacle that the prince restored the "Royal" designation to the Polytechnic. The public's fascination with the illusion made it the talk of the town, and Pepper reportedly earned around £12,000 (roughly $1.5 million today) from eager audiences who flocked to witness the magical effect for themselves (Rossen).

In the case of Tupac's hologram, a computer-generated image was projected onto a highly reflective piece of Mylar stretched over a transparent frame, utilizing this age-old optical trick (Dodson). This setup enabled live performers, including Snoop Dogg, to seamlessly interact with Tupac's hologram, enhancing the realism of the performance.

Despite the ability of holograms to create realistic three-dimensional images that can enhance the attractiveness and impact of a story, this technology also faces significant challenges and limitations. One major barrier is the very high cost, as evidenced by the estimated $100,000 to $400,000 expense for Tupac Shakur's hologram illusion ("Coachella's Astonishing Tupac Shakur Hologram"). Additionally, there are technical limitations in creating clear and accurate images, along with the complexity of content production, which requires specialized skills in modelling and three-dimensional animation (Barnes). These factors contribute to the limited widespread use of hologram technology.

However, recent technological advancements have introduced affordable, accessible three-dimensional imaging models for businesses and individuals. Holofans, a spinning LED

hologram projector, vary in image quality and size. These projectors use rotating disks with LED lights to create holographic images that appear to float in the air, leveraging the principle of persistence of vision. By precisely blinking LED lights during each fan rotation, the eye perceives a continuous floating image. This synchronization of LEDs with fan speed is managed by a computer chip, processing input images or videos to ensure smooth visual output (“Holographic Tech”).

Due to their affordability, ease of use, and high-resolution output, Holofans are widely utilized in advertising, exhibitions, and education. These positive features make them a suitable option for use in various displays and presentations. However, Holofans also present challenges that must be considered for a comprehensive evaluation. Holofans typically have a limited viewing angle, requiring viewers to be positioned correctly relative to the device to avoid distorted or incomplete images. The mechanical nature of Holofans generates noise during operation, which can be disruptive in quiet environments, and the spinning blades pose a safety risk, especially if placed within reach of the audience or performers. Furthermore, Holofans perform best in low ambient light with a black background to create better contrast, limiting their usability in well-lit areas. They are also challenging to capture on camera, requiring the camera's shutter speed to be synchronized with the spinning blades to avoid distortions. Lastly, each Holofan forms an utterly circular image, necessitating multiple fans positioned together to create larger rectangular displays, which can complicate setup and increase costs ("HyperVSN Clone First Look").

2.5.7 Spatial Audio Systems

The evolution of theatre audio systems has transitioned from mechanical sound effects to sophisticated digital technologies. Innovations such as tape players in the 1960s and digital

samplers in the 1980s revolutionized sound editing, enabling greater complexity and precision (Staples). Today, spatial audio systems enhance theatre and live performances by creating immersive, three-dimensional soundscapes that mimic real-life auditory experiences. These systems use advanced audio technologies to create three-dimensional sound, giving the listener a sense of sounds coming from different directions, including above and below.

Technologies like Vector Base Amplitude Panning (VBAP) enable precise sound localization in performance spaces, allowing sound designers to place each sound exactly where desired. These systems provide more realistic and enveloping experiences while watching movies, playing video games, and listening to music and performances. (Blackwood).

The opera *Death and Powers*, produced by the Massachusetts Institute of Technology (MIT) and directed by Tod Machover in 2010, is a notable example of this technology in theatre. In this opera, the main character transforms into a digital entity and, by performing behind the scenes, creates changes in lighting, sound, and visual effects. Advanced audio technologies such as Wave Field Synthesis (WFS) and high-resolution Ambisonics were used in this opera to deliver sounds in a highly realistic, three-dimensional manner. Wave Field Synthesis (WFS) employs an array of speakers to create highly realistic, location-specific sound sources. High-resolution Ambisonics, on the other hand, is a method of recording and reproducing audio in a full-sphere surround sound format, allowing for precise placement of sounds in three-dimensional space and enhancing the realism and depth of the auditory experience (Staples).

Despite their impressive capabilities, the high costs of spatial audio systems pose challenges, particularly for low-budget productions

Chapter 3: Exploring Modern Technologies Integration

Following an examination of advanced technologies and their use in enhancing storytelling, I developed several innovative ideas for my thesis practical project. One of the most compelling concepts was inspired by concerts where hologram technology brought deceased performers back to life in three-dimensional form, such as Tupac Shakur's holographic appearance at the 2012 Coachella music festival.

3.1 Innovative Ideas for Technology Applications in Theatre

In exploring the use of hologram technology in theatre, my goal was to allow deceased actors or celebrities to reappear on stage, perform, and interact with live actors. To assess its potential for re-engaging theatre audiences, I analyzed the media impact and public reception of holographic performances. At the 2012 Coachella Valley Music and Arts Festival, over 100,000 attendees were stunned when a hologram of Tupac Shakur appeared on stage, performing two of his iconic songs. The realistic portrayal of the late rapper, who had passed away in 1996, left the audience fascinated. This remarkable moment sparked intense media attention, and a video clip of Tupac’s performance went viral almost instantly, demonstrating the significant cultural impact of the event ("Coachella's Astonishing Tupac Shakur Hologram").

The Coachella hologram performance showcased the potential of holographic technology to captivate large audiences and generate excitement across both physical and digital platforms. Similarly, the Roy Orbison hologram tour, where fans paid premium prices to watch a virtual version of the late singer perform his greatest hits (Nairn and Matthews), further demonstrated the strong demand for such performances.

3.2 Audience Reactions to Hologram Performances

The success of repeated hologram tours featuring deceased performers, such as Tupac Shakur and Roy Orbison, highlights a strong acceptance and enthusiasm from audiences. These performances, made possible through hologram technology, offer experiences that resonate deeply with both new and longtime fans. For many, re-experiencing live performances of beloved artists evokes nostalgia and emotional connection, allowing audiences to revisit iconic moments. The technical brilliance and visual impact of holograms help bridge the gap between past and present performances, making the experience both memorable and immersive.

In addition to these performances, the ABBA Voyage concert, featuring digital avatars of the legendary Swedish band, provides another example of how hologram technology can captivate audiences. A study analyzing over 34,000 online comments on fan responses to ABBA Voyage revealed that people greatly appreciated the chance to witness the iconic band "perform" once more. One fan remarked, "It would be so wonderful to see them as I remember them and transport myself back to my childhood. It's like the closest thing to time travel" (Nairn and Matthews 239). Another fan highlighted the timeless appeal of the digital avatars, stating, "I find the fact they use the ABBAtars instead of themselves on stage simply an amazing idea. It keeps us feeling young and them timeless" (Nairn and Matthews 291). The enthusiastic reception of these hologram-based performances underscores the public’s excitement for innovative concert experiences that blend cutting-edge technology with beloved musical performances.

Furthermore, this technology enhances audience engagement by integrating historical performances and blending classic with modern elements, including the revival of deceased characters. This enables innovative productions and new artistic approaches in theatre.

3.3 Using Hologram Technology in Theatre

When I chose to use hologram technology to bring a deceased actor to life on the theatre stage, my goal was to explore the potential of this technique in theatrical productions. Although this method may have been attempted in theatre, I found no documented cases. Therefore, I turned to research on how this technology has been used in concerts featuring deceased singers. In the holographic performance of Tupac Shakur, a combination of advanced computer graphics and audio tricks on past videos of the artist was utilized to create fresh movements and new dialogue ("Coachella's Astonishing Tupac Shakur Hologram"). To achieve the lifelike appearance of Tupac, the visual effects team at Digital Domain combined footage from Tupac's final live performance with bespoke computer-generated imagery. This process included creating detailed animations of Tupac's facial expressions and body movements to match his unique style. By altering and editing the videos, the team was able to craft a projection that looked remarkably real, conveying a sense of three-dimensional imagery and the actual presence of the character to the audience (Dodson).

Although the exact technique behind the technology is still unknown, and there is no detailed information about the steps followed, my main requirement was access to high-quality videos of the deceased actor I wanted to cast in my play. However, this seemed impossible because finding full-body, high-quality videos of a complete performance from a specific actor is extremely difficult. Even if such videos exist, we would face the problem of interference with other actors in the video, and would not be able to isolate just the artist's image from the background. Furthermore, if we wanted to use that actor in a completely new play, in which they had not performed in their lifetime, past performance videos would be useless because they contain different dialogues and portrayals.

3.4 Deepfake Technology as an Innovative Approach

Deepfake technology offers a potential solution for generating high-quality, isolated video footage of deceased actors in new theatrical productions. This technology uses advanced artificial intelligence to create realistic images or videos of people performing actions they never actually did.

Deepfake technology employs deep learning algorithms that analyze extensive data of images and videos to learn patterns of facial expressions, movements, and voices. These patterns are then reconstructed to generate high-quality, lifelike depictions of characters performing novel actions or delivering new dialogue (Mulko).

This innovative approach is increasingly popular in the film industry for special effects, such as rejuvenating actors or altering their appearances. It is also used for entertainment purposes, generating amusing and interesting videos. By leveraging Deepfake technology, theatre productions can overcome the limitations of traditional methods, offering a new way to bring deceased actors to life on stage.

Despite its potential for innovation, Deepfake technology raises significant ethical and legal concerns. These may include potential infringement on intellectual property rights and the need to obtain consent from families and descendants. Despite the potential for innovation with Deepfake technology, some people may oppose its use to recreate images of deceased actors. This process could lead to discomfort regarding authenticity and respect for the individual's memory. On the other hand, some may support this technology for its ability to create realistic reconstructions and reintroduce these characters in new theatrical performances. I believe that using Deepfake technology to recreate the performances of deceased actors not only preserves their legacy and enhances artistic appeal but also provides sentimental and financial benefits to

their families. To ensure the ethical use of this technology, I examined legal frameworks in the United States and Canada. In the United States, there is no uniform federal law for Deepfakes, but states such as California and Texas have enacted laws prohibiting the use of Deepfakes in areas like election advertising, pornography, and non-consensual use (Gibson and Newman; Briscoe). In Canada, laws do not specifically focus on Deepfakes. However, existing Canadian laws prohibit the non-consensual distribution of intimate images and include laws against misinformation for electoral candidates, which may be applicable in the realm of Deepfakes (Siekierski).

3.5 Choosing Suitable Hologram Projectors

After confirming the effectiveness of Deepfake technology in realistically recreating the image and voice of a deceased actor, the next challenge was selecting a suitable hologram projector and necessary equipment for the theatre production. The main challenge was to identify a cost-effective solution that fit the university project's budget while providing high-quality visual output to convincingly and impressively recreate the actor's image on stage.

Based on my research on hologram technology, Holofan projectors emerged as a suitable option. These projectors offer high image quality at a reasonable price. Although primarily known for advertising or decorative purposes, Holofan projectors seemed perfectly suitable for my implementation. Therefore, I focused on finding the best option in terms of quality, image size, and price.

These hologram projectors consist of rotating blades equipped with multiple LEDs, powered by an electric motor similar to a fan. These fans come in various sizes, ranging from small monitor-sized units to larger wall-sized setups consisting of several rotating LED fans mounted on interconnected bases. The image quality varies and can range from 768 pixels to

2840 x 1180 pixels, depending on the technology used in the projector. The content of these projectors is controlled and managed either remotely via an internet connection or through a cable connected to a PC ("Best 3D Hologram Fan Large Size").

Based on my research, I identified a model featuring three holographic fans mounted vertically on a stand. When these fans rotate together, they create a lifelike, full-size image of a human. This model is known as the "3D Holographic Human."

After extensive research by the production manager and the procurement specialist, who is responsible for purchasing equipment for the production, it was discovered that no such options were available locally in Canada. Consequently, I found a company in China that produces these human-sized projectors, which can produce high quality images and are offered at a reasonable price. The company offered three projector models, with image sizes ranging from 65cm x 155cm to 100cm x 241cm.

To ensure the digital actor’s presence remains convincing, even for audiences in the back rows, I recommended the largest model, the SH-F100. This projector has image dimensions of 100cm in width by 241cm in height and a resolution of 1180 pixels by 2840 pixels.

3.6 Optimal Conditions for Hologram Display

The following steps should be followed to display a three-dimensional image of a person using these projectors: First, film the subject in front of a green screen. Then, remove the background from the video using video editing software. Once this is done, upload the final file to the specialized hologram projector software to display the image. As the holographic fans rotate, they display a background-free image, creating the illusion of a person floating in mid-air. For optimal image quality, the hologram projectors should be positioned against a dark

background with soft lighting. A dark background reduces visual distractions and enhances the contrast between the holographic image and its surroundings, making the image appear more vivid and defined. Soft lighting minimizes harsh shadows and reflections that can interfere with the clarity and colour accuracy of the hologram. This combination of a dark background and soft lighting conditions ensures the holographic image is seen in its best form, with optimal colour representation and clarity (Fig. 6.3).

3.7 Choosing *A Seussified Christmas Carol* Play

After confirming the feasibility of using hologram and Deepfake technology to recreate a deceased actor's performance, I selected Peter Bloedel's *A Seussified Christmas Carol* for my theatrical production. This play narrates the story of Ebenezer Scrooge, who transforms from a cold-hearted and antagonistic individual into a kind and compassionate person after encountering the ghost of his former colleague Marley and the ghosts of the past, present, and future. These encounters, full of twists and peculiar challenges, enable him to travel through time and witness the consequences of his actions.

Several factors influenced my selection of this play: its unique storyline, which challenges the constraints of time and space; its playful and creative adaptation that appeals to a broad audience; and its alignment with Dr. Seuss's fantastical world, making the inclusion of a deceased actor both plausible and meaningful. To understand these factors better, I will explain each one in detail.

A key reason for selecting *A Seussified Christmas Carol* was its storyline, which explores time-travel and features four spirits, an ideal framework for integrating performances by deceased actors. The Ghost of Christmas Past, in particular, could be played by a beloved late artist, enhancing the role's emotional depth and audience connection. This choice adds a profound layer

of meaning to the role, as the actor, much like the character they portray, comes from the past and is no longer physically present. Using a hologram to bring this actor to life on stage makes their appearance ghostly and ethereal, aligning perfectly with the Ghost of Christmas Past character. This approach enhances the believability of the ghostly figure and symbolically bridges the gap between past and present, reinforcing the theme of time and memory within the play.

Secondly, *A Seussified Christmas Carol* is a playful and creative play that blends Charles Dickens' *A Christmas Carol* with the whimsical world of Dr. Seuss, broadening its appeal and engaging a wider audience. This expanded target audience was another reason for choosing this play for my final project, aimed at attracting more viewers. Indeed, Bloedel ingeniously presents classic Dickensian literature in a Seussian style, making it more comprehensible and enjoyable for young people, especially children. *A Seussified Christmas Carol* engages and entertains adults by seamlessly blending the timeless messages of Dickens' classic with the whimsical charm of Dr. Seuss. Its humor, imaginative dialogue, and clever wordplay engage adults who appreciate nostalgic and inventive storytelling. The themes of transformation, redemption, and the importance of kindness are woven into the narrative in a way that resonates with mature audiences, offering a thoughtful and emotionally-rich experience.

Finally, the predominant style of this play is Seussian, inspired by the creative style and worlds of Dr. Seuss, one of the most famous children's book authors and illustrators known for his cheerful rhythms, melodious rhymes, and colourful, imaginative illustrations. Dr. Seuss’s illustrations are uniquely suited for extraordinary and fantastical storytelling, blurring the boundaries of reality where the impossible feels ordinary. For example, animals talk, machines and structures are unconventional and bizarre, and common laws of nature-like gravity and physics are defied, creating spaces where imagination can grow boundlessly and enable any kind

of extraordinary occurrence. In such a whimsical and imaginative setting, the return of deceased actors to the stage aligns perfectly with the play's overall style, feeling natural and fitting. The play's Seussian style encourages audiences to suspend disbelief, making the presence of a deceased actor feel natural within the narrative

3.8 Creative Ideas

This section explores two innovative concepts that leverage advanced technologies to enhance the theatrical experience. These concepts include portraying the Ghost of Christmas Yet to Come as a digital cartoon character and using hologram technology to collaborate with a renowned live actor.

3.8.1 The Ghost of Christmas Yet to Come as a Virtual Cartoon Character

In addition to the Ghost of Christmas Past, the play features three other ghost characters. To enhance the production, I aimed to use hologram technology to visually represent two of these characters as well. Specifically, I envisioned the Ghost of Christmas Yet to Come as a 3D digital cartoon character interacting with live actors. The character, Sven, is described in the play as a tall figure with a long cloak, a futuristic space helmet, and other high-tech accessories, with a face that is never revealed. Sven communicates through thought using a space-aged-looking gun that emits mind-power rays. I planned to use animation and design software to create and model this character, emphasizing his futuristic attributes to make his appearance more impactful.

This approach aimed to visually highlight the contrast between the past, present, and future ghosts, enhancing the whimsical and imaginative style of the play to engage the audience. Additionally, featuring a digital cartoon character was intended to seamlessly integrate digital elements with live theatre, creating a captivating theatrical experience. However, due to the

extensive time and resources required for modeling and animating the character, our production group ultimately abandoned this idea.

3.8.2 Collaborating with Famous Actors via Holography

Research indicates that including well-known actors can significantly boost ticket sales and viewership. A study titled "Influence of Star Power on Movie Revenue" found that the presence of stars positively impacts box office revenue, highlighting the importance of "star power" in drawing audiences (Kim et al.). Based on this understanding, I explored the possibility of utilizing hologram technology to feature a renowned actor in the role of Marley on the University of Lethbridge theatre stage. This star power could enhance the show's immediate appeal and attract more attendees because of the actor's fame and influence. Initially, I considered collaborating with an internationally renowned actor whose three-dimensional image could be projected onto the stage in real-time, allowing interaction with live actors without physical presence.

Real-time holographic projection involves using special cameras called depth sensors, like the Microsoft Kinect V2, to capture a three-dimensional image of a person. These sensors capture both the colour and depth of the subject in relation to the camera. The background is then removed from the image, leaving only the person. This data is used to create a 3D model by connecting points to form a surface, similar to how 3D movies create images. The 3D model and the person's voice are compressed to make it smaller and sent over the internet to another location. There, the data is decompressed and displayed using a holographic projection system, which creates a lifelike 3D image (Fadzli et al.).

Featuring an internationally renowned actor via holographic technology could have expanded the audience base by attracting both the actor’s fans and expatriates from their home

country. The global reach of renowned actors enhances their 'star power,' making performances appealing across different countries. Additionally, it could have opened opportunities for global collaborations with theatre actors, allowing for diverse cultural exchanges without their physical presence at the performance venue. This approach would have had numerous benefits for both the actors and theatres, such as increasing ticket sales, potentially reducing production costs by eliminating travel and accommodation expenses and making access to the actor easier and more flexible. Upon estimating the budget for producing *A Seussified Christmas Carol*, our production group abandoned the idea because of the high costs involved. Our primary focus was on purchasing a hologram projector, and the additional expenses of hiring a well-known actor and providing necessary equipment such as cameras, renting a green-screen-equipped studio abroad, makeup, and costumes exceeded the budget allocated for this university production. Thus, implementing this idea proved financially unfeasible.

3.8.3 Renowned Actor Simulation via Deepfake and Holography

Due to production constraints, direct collaboration with a famous actor was unfeasible. However, my research demonstrated that it was possible to create the image of the Ghost of Christmas Past actor using holography and Deepfake technology. This approach could also be extended to simulate the image of a living renowned actor, making Deepfake technology a versatile and practical tool for theatrical production.

The hologram projectors and Deepfake technology, initially intended to create the image of a deceased actor, enabled us to implement the idea without adding extra costs to the production. By utilizing Deepfake and holography, we could create a three-dimensional representation of a renowned actor at no additional cost.

Following extensive discussions with director Ryan Reese and the creative team, we decided to use this technique for Marley's role. This decision enabled the casting of a well-known actor to perform at the University of Lethbridge theatre while still staying within budget constraints and maintaining the star power and appeal of featuring a renowned actor.

Ultimately, time and budget constraints forced us to abandon our plans for a virtual Ghost of Christmas Yet to Come and a holographic collaboration with a famous actor. Instead, we came up with a new idea: simulating renowned actors using Deepfake technology and holography, allowing us to achieve a similar innovative effect. This shift in approach highlighted the flexibility and potential of Deepfake technology in the theatre. Our academic project aimed to experiment with these emerging technologies, showcasing the potential of Deepfake to revolutionize art and entertainment. Future productions must prioritize legal and ethical considerations, adhering to copyright and personal rights laws in the use of Deepfake technology.

3.9 Design Strategies

This section will outline the comprehensive design strategies used in producing *A Seussified Christmas Carol*. These strategies integrated various elements to create a distinctive and engaging visual experience. The following sections will cover the Creative Approach, Design of Backdrops, Inspiration from *The Nightmare Before Christmas*, Linking Characters, and Creating Distinct Spaces for Different Time Periods.

3.9.1 Creative Approach

In my creative approach to the production, I aimed to reshape reality by modifying familiar elements to exist in a slightly altered realm. The design featured exaggerated shapes and striking contrasts. Taking inspiration from Dr. Seuss' style, known for its whimsically distorted

creatures and settings, I integrated spiral lines, bold patterns, and fluid, curvy lines into the set design. The visual experience that resulted was both recognizable and distinctly different from ordinary reality. This approach proved effective in the production of the play *A Seussified Christmas Carol*, which combines the narrative skeleton of Charles Dickens's *A Christmas Carol* with the colourful and wondrous world of Dr. Seuss.

I aimed to seamlessly merge two distinct worlds by using traditional Victorian designs as the primary basis of my layout and adding elements from Dr. Seuss' world. This combination was chosen to highlight the whimsical transformation of a classic tale, blending the familiar Victorian aesthetic with the playful and imaginative style of Dr. Seuss to emphasize the fantastical reinterpretation of Dickens' narrative.

For instance, I incorporated a Victorian bench as a base design, embellishing it with spiral lines and bold, high-contrast colors (Fig. 2.2, 2.3). The designs aimed to convey a fantastical and cartoonish feel, providing a new yet familiar experience for the audience where tradition and imagination coexist.

3.9.2 Projection Screen

In *A Seussified Christmas Carol*, there are 15 locations, some featuring very short scenes that required rapid transitions. After researching modern scenographic techniques, I chose to use digital projection screens as backdrops. The increasing integration of digital technologies in modern theatre drove this decision, as they offer spatial flexibility beyond traditional set designs. Renowned 20th-century figures, stage designer Robert Edmond Jones and French director Jean-Louis Barrault, both emphasized that theatre fundamentally involves the struggle of a human being in space, and projections can enhance this experience by framing two-dimensional spaces that simulate dynamic, three-dimensional environments (Dixon 335). Additionally, as Steve

Dixon points out in his book *Digital Performance*, projection media can manipulate time and space instantly through editing techniques, making it possible to shift from one visual setting to another seamlessly, which is essential for productions requiring frequent transitions. This choice allowed for fast and smooth scene changes, minimizing the need for physical set alterations. Each set design was meticulously crafted and projected onto the screens, pre-aligned with the play's dialogue and action, ensuring seamless transitions (Fig. 6.6-6.8).

Although a minimalist approach with fewer physical elements could have been an option, it would not have aligned with Dr. Seuss' lively and playful aesthetic. Using digital projection screens allowed us to fully capture the whimsical and vibrant nature of Seuss' style, which relies on bold colors and imaginative designs, while also meeting the practical demands of quick scene transitions.

The increasing integration of digital technologies in modern theatre further supported the decision to use projection screens. These advancements have revolutionized stage design, enabling more versatile and dynamic performance spaces. Digital projections expand the spatial possibilities of the stage and enhance audience engagement by incorporating elements such as hyperrealism and special effects, which would be difficult to achieve with traditional set designs (Tonkoshkura).

In our production, the projection screens enabled us to capture the playful and colorful essence of Dr. Seuss' world. Rather than static backdrops, we incorporated animations such as falling snowflakes, flickering candlelight, rising chimney smoke, and dancing flames in the fireplace. These animated elements brought the virtual images to life, immersing the audience in Seuss' whimsical and animated universe, something that a minimalist set could not have achieved.

3.9.3 Projection Screen Design

In designing the backdrop images, I focused on creating detailed and imaginative visuals for each location in the play, such as Scrooge's office, his bedroom, Fred's house, and the streets of London. My goal was to seamlessly integrate projections with live stage elements, enhancing the audience's perception of space and location. Each image depicted a whimsical, cartoonish version of the play's settings, bringing the Seussian world to life with quirky shapes, playful patterns, and vibrant colours. To unify these visuals, I incorporated set pieces in front of the projections, ensuring that the props' colours and patterns matched the Seussian aesthetic. For instance, the projection of Fred's room included wavy lines, high-contrast colours, and Seussian elements that perfectly aligned with the colours, patterns, and sizes of the chairs and sofa in front of the screen (Fig. 5.5, 6.7).

An important influence on this design approach was Alladeen (2003) by The Builders Association, where large projection screens vividly depicted a range of settings. In Alladeen, digital backgrounds played a crucial role in establishing the locations. Large projection screens showcased bustling New York streets, such as a Virgin Megastore, before seamlessly shifting to a call center in Bangalore, India. These dynamic, computer-generated visuals were integral not only in creating the settings but also in enhancing the narrative, as they blurred the boundaries between digital and physical spaces. The screens transported the audience from one location to another, making the digital backgrounds a vital element in conveying the globalized context of the story (Dixon).

In a similar vein, using digital backdrops allowed me to create detailed visuals for each setting, emphasizing the play's style and conveying concepts relevant to each scene. For example, in the backdrop image of Scrooge's room (Fig. 5.2), odd-shaped figures like a grandfather clock

with exaggerated features, vibrant colors with high contrasts, and fantastical details emphasized the Seussian style of the play. Moreover, these visual elements also reflected Scrooge's character and the play's narrative. Specifically, the large clock symbolizes the passage of time and Scrooge's impending confrontation with his past, present, and future. Additionally, the mirror represents introspection and self-reflection, which Scrooge encounters throughout the story. The chests symbolize his greed and obsession with hoarding wealth amidst his chaotic and inefficient living environment. To further highlight his personality, the colors were chosen with intention, with green representing his envy and loneliness, evoking a sense of bitterness and discontent, and purple alluding to his wealth, yet also his isolation and distrust of others, portrayed in a fantastical and exaggerated manner.

To emphasize the Seussian elements of the play *A Seussified Christmas Carol*, I highlighted Dr. Seuss style in the design of the settings and backdrops by adding details such as spiral lines, polka dots, and fluid, curvy lines. To further enhance the whimsical Seussian style, Ryan suggested integrating characters from Dr. Seuss' works into the backgrounds, aligning their symbolism with the play's characters. For example, Max the dog was included in Fred's house as his pet, symbolizing loyalty and his friendliness toward Scrooge. Emphasizing Seussian elements facilitated the audience's quick connection and understanding of the play's style, allowing them to engage more deeply with the story through familiar characters and settings.

Projected backdrops enhanced the depth and perspective of each scene. For instance, the Country Lane backdrop featured lively hills and rural houses at varying distances, with winding paths extending, enhancing the scene's depth and perspective (Fig. 5.3). Similarly, the sea backdrop depicted colourful ocean waves with fishing boats positioned close and far, giving the sea setting greater depth (Fig. 5.4).

To enhance a specific scene in Act 1, Ryan and I had an idea to make the visual dynamics and engagement more compelling. In the play, when Scrooge leaves his shop and heads home, he passes by people on the street and becomes disgusted by the Christmas atmosphere. Eventually, he approaches his front door, where he sees Marley's face appear on the door knocker. To make this transition more visually compelling, we decided to have the backdrop images of shops, houses, and street views move backward as Scrooge moves forward. Animating the backdrop images created the illusion of Scrooge passing storefronts and houses as he moved toward his home (Fig. 6.11, 6.12). By synchronizing the digital backdrop's movement with Scrooge's actions, we aimed to create a more cohesive experience for the audience. This method could enhance the scene's appeal and bridge the gap between digital imagery and physical performance, making the audience feel like they are moving with Scrooge through the streets.

Here is the passage that inspired our idea:

> *The Scrooge wanders through the merry people on the streets, scowling and snapping at them. The people are obviously scared of him and keep their distance. Some mock him, but none of this bothers Scrooge.*
>
> NARRATOR #1: To cut through the crowds full of mirth was a chore, but before long The Scrooge faced his own door (Bloedel 14).

In conclusion, with whimsical visuals, dynamic animations, and careful synchronization with the actors' movements in the design of the projection images, we aimed to create a cohesive and captivating experience, enhancing the audience's overall engagement with the performance.

3.9.4 Inspiration from *The Nightmare Before Christmas*

In designing the set for *A Seussified Christmas Carol*, the creative team and Ryan took inspiration from Tim Burton's *The Nightmare Before Christmas*. Ryan believed this approach would enhance the visual experience and emphasize the contrast between Scrooge's world and the festive Christmas atmosphere. Additionally, incorporating elements from Burton's film made our production more appropriate for its October schedule, aligning with the Halloween season. Burton's stop-motion musical, released in 1993, blends Halloween and Christmas themes, creating a visually striking and distinct style. The film's story follows Jack Skellington, the Pumpkin King of Halloween Town, who becomes enamoured with Christmas and attempts to bring its joy to his town, leading to both catastrophic and fascinating outcomes.

Tim Burton's distinctive stylistic choices align well with the whimsical and fantastical nature of Dr. Seuss world in *A Seussified Christmas Carol*. Both styles twist reality to create extraordinary, surreal environments that would be recognizable and familiar yet different from our world within stories that highlight family, friendship, and festive celebration themes. However, their design elements differ: *The Nightmare Before Christmas* features dark and gothic elements with sharp textures and muted colours, evoking a spooky, Halloween-like atmosphere, whereas Dr. Seuss' aesthetics are playful, vibrant, and colourful. Juxtaposing eerie and cheerful elements accentuated the play's thematic contrast, amplifying the impact of its darker moments. This contrast underscores the joy of Christmas against Scrooge's bleak world, enhancing the play's tone, which is both spooky and playful.

For example, in the graveyard scene where the Ghost of Christmas Yet to Come shows Scrooge his gravestone, I incorporated prominent elements from *The Nightmare Before Christmas* in the backdrops, such as twisted trees, eerie lights, colours, and shadows (Fig. 5.6,

6.13). Using Burton's style prominently in specific scenes deepened the play's messages by creating meaningful contrasts between dark scenes and festive joy and made the production more relevant and engaging for the season between Halloween and Christmas. This approach served as a bridge between the two holidays, enhancing the play's relevance to its performance time.

3.9.5 Linking Characters

Expanding on the visual styles, we also explored the symbolic connections between the characters. Combining the Seussian style with the story of *A Christmas Carol* in the play A *Seussified Christmas Carol* is a natural fit. Dr. Seuss' *How the Grinch Stole Christmas* shares thematic similarities with *A Christmas Carol*. In *How the Grinch Stole Christmas,* the Grinch is unhappy with the joy and celebrations of the people in Whoville and decides to steal Christmas from them. Throughout the story, the Grinch transforms, ultimately returning everything he stole and joining the Christmas celebrations, finding joy in the process. Both stories emphasize themes of change and redemption, the importance of community and family, and end on a positive, hopeful note. These thematic and narrative similarities facilitate their combination and adaptation into a new format, such as *A Seussified Christmas Carol*.

Despite differences in narrative style and story details, *A Christmas Carol, How the Grinch Stole Christmas*, and *The Nightmare Before Christmas* share themes of transformation and redemption. Each protagonist undergoes a profound transformation: Scrooge and the Grinch shift from despising Christmas to embracing it, while Jack Skellington rediscovers his appreciation for Halloween and his role in it. To visually represent the symbolic connection between these three characters in the set design, I used the colour green, commonly associated with the Grinch, in settings related to Scrooge. Additionally, I incorporated elements from Jack

Skellington's room, such as large windows with irregular and angled lines, to enhance the thematic unity across the stories.

3.9.6 Creating Distinct Spaces for Different Time Periods

To enhance the audience's understanding and connection with Scrooge's temporal journey, I designated specific areas on stage for each past, present, and future scene. Because of its strategic positioning at the heart of the performance and optimal visibility for the audience, the center of the stage was chosen as the location for the present events, which comprise most of the play's scenes.

The upstage area was designated for past events, serving as a space where memories and earlier scenes unfolded. For the future, the area at the front of the center stage, closest to the audience, was designated not only to maintain a logical sequence of time but also to convey a sense of immediacy and closeness to the events about to unfold. This arrangement provided a clear and organized structure, helping the audience easily follow the shifts in time. In addition, the play refers to street locations in both the present and the future, so I designed a street along the proscenium wall between the present and future time areas to serve as the entryway to these two designated locations.

To enhance the temporal experience, I designated projection screens for each section, displaying images corresponding to their respective time periods (Fig. 6.2) To frame the images and hide the surroundings and top of the screens, I used two legs, which are long black curtains, on the left and right sides, and a horizontal border at the top of each screen. These legs and the top border framed the projections, ensuring a clean and unobstructed visual presentation.

Additionally, on the right and left sides of each screen, I designed two panels that were height-aligned with the projection screens. These panels featured abstract paintings and a colour palette compatible with the digital images on the adjacent projection screens. The paintings emphasized the whimsical and surreal style of the play by incorporating vibrant colours and fantastical elements. The cohesive colour palette and abstract designs created a seamless visual connection between the digital and physical elements of the stage, enhancing the overall aesthetic. The integration of these panels also added depth through the interplay of light and shadow on the panels. This dynamic effect added visual interest, supporting the atmosphere of the play during screen transitions and the absence of digital images (Fig. 2.5- 2.8). The screens and panels alongside them defined the designated spatial boundaries and acted like gateways guiding actors and the audience from one time period to another. For example, when it was necessary to transition from the future to the present, the screens and side panels associated with the future scenes, located downstage, would rise, and the screen and panels for the present time in the center of the stage would descend, displaying images related to the present scenes. To optimize actor movement and audience visibility, I designed tiered platforms, creating a stair-like effect that added depth to the stage. These platforms elevated the stage levels from bottom to top, dividing it into three distinct parts and emphasizing the areas designated for different times (Fig. 6.1).

The director and I needed to ensure that an open and accessible space was available to better manage the high number of actors and frequent set changes. Therefore, I strived to maximize the use of available stage space and designed wide and accessible entry and exit paths from the right and left sides of the stage.

This strategic staging allowed actors and audiences to seamlessly experience Scrooge's journey through past, present, and future, navigating the story with clear visual cues.

Additionally, this approach heightened the intrigue and mystery of the performance by gradually revealing the play's temporal and spatial layers

Chapter 4: Implementation Process

In this section, I explore the integration of emerging technologies in the production of *A Seussified Christmas Carol*. The discussion begins by outlining the criteria and decisions for selecting actors to portray key roles using holographic and Deepfake technologies. I then address the budget constraints and technical adjustments that were necessary to implement these technologies, including the cost-saving measures and safety regulations that were considered and ultimately followed.

The final implementation covers the static use of holograms. I explain the method of applying Deepfake technology and the setup of backdrops and screen projections, highlighting the visual enhancements achieved through animated designs.

Challenges faced during rehearsals, such as synchronization and video playback issues are also discussed, along with the solutions devised to ensure the performance's successful execution.

4.1 Selection Criteria and Actor Choices

In the preproduction meetings, which began on April 10, 2023, the initial step for implementing the holographic plan and recreating images of famous actors for the roles of Marley and the Ghost of Christmas Past was selecting individuals whose personas and acting styles closely aligned with the traits and characteristics required for these roles.

In the play *A Seussified Christmas Carol*, the appearance of the ghost of Jacob Marley is defined as follows:

> *He is wearing a particularly gaudy outfit. Dragging behind him from his waist are a train of big bean bag chairs, and a bird cage at the end. He's not particularly scary. He has a "street smart," east coast accent.* (Bloedel 15)

Hollywood actor Danny DeVito seemed a suitable choice for this role because of his distinctive and memorable performances in various eccentric and quirky roles. For instance, his portrayal of the Penguin in the 1992 film *Batman Returns* showcased his ability to bring depth and complexity to characters, making them memorable.
Furthermore, as a New Jersey native (DeVito), DeVito has a distinctive East Coast accent and speaking style that perfectly match Marley's description, adding authenticity to the character.

In the play, the Ghost of Christmas Past is described as "*a funky little ghost done up in rock and roll attire*" (Bloedel 20). When choosing an actor for this character, considering that the play depicts him wearing rock and roll attire and was initially conceptualized as a famous deceased individual returning to the stage, Elvis Presley immediately came to mind. He is a renowned singer and actor as well as an iconic symbol of rock and roll. Choosing him could enhance the story by aligning perfectly with the play's description of the Ghost of Christmas Past. Additionally, it would create a strong emotional connection to the past and evoke a sense of nostalgia for the audience. His personality, appealing appearance, and unique dress style could help create an immediately recognizable image for the audience, providing an engaging experience. When these actors were suggested to Ryan, he enthusiastically welcomed the idea and selected them for the roles of Marley and the Ghost of Christmas Past.

4.2 Director’s Decision on Deepfake Technology

After casting, Ryan decided to use Deepfake technology to alter only the performers' faces to resemble Danny DeVito and Elvis Presley, while keeping the performers' original voices. This decision was made for two main reasons. First, he wanted the actors to use their skills to mimic DeVito’s and Presley’s voices. Second, to mitigate potential technical issues, such as interruptions in the digital image broadcast, he ensured that the performers were prepared backstage in full

makeup and costumes to resemble the characters. Ensuring that the performers' live voices matched the Deepfake visuals, the goal was to maintain consistency for the audience, making it appear as though the same actor was both on stage and in the digital display. Although this decision was very prudent for contingencies, it significantly diverged from the original intention of fully recreating these actors on stage, and I believe negatively affected the audience's perception of these characters. This decision made it difficult for the audience to recognize the characters as Danny DeVito and Elvis Presley, generally weakening the intent to use these actors. However, Ryan was concerned about potential technical issues. Considering the possibility of problems such as power outages or malfunctioning hologram projectors during the performance, his priority was to prevent any sudden changes in character traits in the middle of the show. Consequently, he firmly upheld this decision, opting against altering the performers' voices through Deepfake technology.

4.3 Budget Constraints

Effective budget management was a crucial aspect of our production process. Initially, we aimed to incorporate the largest available "3D Holographic Human" projector, the SH-F100, to maximize the visual impact. However, a deeper financial analysis revealed that our budget could not accommodate the high costs of this projector. The SH-F100 projector, including shipping and auxiliary equipment, cost between $2,800 and $3,000 USD. Even with efforts from the creative team and production manager to prioritize spending on the projector over other scenic elements, the total cost still exceeded our budget (see Table 4).

In response, the production manager suggested an alternative: the SH-F65, a lower-end model from the same company. This device offered a lower resolution and a smaller image than the originally proposed model. However, we recognized the importance of having a high-quality,

human-sized image to enhance believability and maximizing audience impact. Depicting the spirit as human-sized was essential to align with the audience's expectations and enhance the credibility of its presence both in the story and during the live performance.

To accommodate these constraints, I simplified the prop design by removing or modifying certain scenic elements. This cost-saving measure allowed us to reallocate the budget toward a better hologram projector—the SH-F80 model, which produced an image size of 191 x 80 cm and boasted a resolution of 928 x 2240 pixels, ensuring a high-quality display. It is important to note, however, that while this model delivered excellent visuals, it required a black backdrop and low ambient light to enhance contrast and ensure a clear projection. Additionally, the university's storage provided a router and necessary connections, reducing costs and allowing us to purchase only the projector, which included a stand and three controllable rotating fans.

4.4 Safety Regulations and Adjustments

Initially, the plan was to use the hologram projectors for both Marley and the Ghost of Christmas Past. After Marley's performance in the early scenes, the device would be relocated for the appearance of the Ghost of Christmas Past. However, this plan encountered significant issues. According to Alberta Occupational Safety regulations and the university's safety committee, the hologram projectors' three rapidly spinning, unprotected blades posed a considerable risk to actors and crew. Although it was initially believed that maintaining a safe distance and issuing warnings would suffice, both the university's safety policies and Alberta's workplace laws required that the device be either shielded with protective guards or placed far enough away from people to eliminate any risk. This unexpected requirement, however, could reduce the impact of the holographic image on the audience, as increasing the distance from the ground and viewers

made it difficult to discern facial details and the clarity of Marley's image—diminishing the 3D illusion that worked best when viewed up close.

Additionally, the hologram projectors had technical limitations that complicated their use. Their sensitivity and fragility made them impractical to move during the show, as any relocation risked misalignment and image distortion. Furthermore, since the projector needed to be connected to a PC via a wired connection, there was a risk of cable disruptions with any movement.

Addressing these safety concerns required either covering the entire device with a protective guard or purchasing specific protectors for each blade. Yet, neither option was ideal. Buying protectors would increase costs and potentially affect image quality, diminishing its three-dimensional effect. Thus, we decided to keep the hologram projectors at a safe distance from people, ensuring both safety and the quality of the holographic effect.

Given the challenges of moving the device, Ryan and I decided to use the hologram projectors solely for displaying Marley. This setup was feasible because Marley appeared in just one scene and remained in one location, Scrooge's room. In contrast, the Ghost of Christmas Past needed to move from the center of the stage to the upstage for a journey to the past, requiring significant stage movement that the hologram projectors' limitations could not accommodate.

4.5 Placement of the Hologram Projector

Proper placement of the Holofan required consideration of its limited viewing angle. As Holofan projectors create only a 3D illusion rather than a true three-dimensional image, their internal components, such as blades and the motor, become visible from side angles. To address

this issue, the projector was placed deeper on the stage to hide it from side angles, ensuring that the audience could only view it from the correct, front-facing perspective.

Furthermore, Alberta's labour regulations mandate that any rotating object, such as a ceiling fan, be installed at least 7 feet above the ground, a rule that also applies to the projector. This requirement proved challenging in the confined space of Scrooge's room, as it forced him to look almost directly upward when addressing Marley. This setup deviated from my original vision, which was to have Marley's ghost appear alongside the live actors, interacting closely to enhance the scene's impact.

Despite these challenges, we could successfully incorporated Marley's holographic image, reinforcing my decision to continue using hologram projectors in the production. I made this decision because technology played a pivotal role in the project. My thesis focuses on increasing live theatre attendance by innovating with emerging technologies to attract more audiences, and hologram technology was the critical innovation in my project that could provide valuable insights into these areas. It could enable us to creatively present the ghost of Marley in *A Seussified Christmas Carol* in a way that traditional methods could not achieve. Moreover, the technology could allow us to explore its practical applications and assess the feasibility of featuring the desired character on stage.

Therefore, I located the hologram device in the ground plan between the middle stage screen and the right-side painting, exactly where the background was covered with a black curtain, resulting in the best image quality. From a narrative perspective, this location was suitable as well because it was behind Scrooge's chair, and the appearance of Marley's ghost there could surprise Scrooge (Fig. 3.3, 3.4, 6.4).

4.6 Displaying the Ghost of Christmas Past on Screen Projectors

As using hologram projectors for Elvis Presley's digital image was no longer feasible, we decided to integrate his video into the backdrop images instead. To achieve this, the Ghost of Christmas Past video was modified using Deepfake technology to replace Elvis Presley's face. The edited video was then imported into Adobe After Effects for background removal before being integrated into the digital backdrops. The background-free video could then be integrated into the digitally-designed backdrop images. By carefully adjusting the position, lighting, and colour correction, the final output could be rendered to appear seamless. This process could make it seem as if the Ghost of Christmas Past was part of the virtual world of the digital backdrops, appearing believably within the digital settings. For example, in the digital backdrop of Scrooge's room, which includes a window, the Ghost of Christmas Past could stand by the window, giving the illusion of being in Scrooge's room, but in its virtual part (Fig. 5.2).

In this setup, the Ghost of Christmas Past would first appear on the central display screen, representing Scrooge's room, and then, as the scene transitioned to the past, he would reappear on the upstage display screen. While integrating the Ghost of Christmas Past video into the digital backdrops was a solution born out of technical limitations, it ultimately enhanced the connection between the real world and the digital environment. This was particularly effective because Scrooge, performing live on stage, had to interact and converse with the digitally projected Ghost of Christmas Past. This interaction not only strengthened the audience's engagement with the digital backdrop but also seamlessly linked the physical and virtual spaces within the performance.

4.7 Deepfake Technology Implementation

The Deepfake project was assigned to a student named Chelsea White from the New Media Department. Our goal was to use Deepfake technology to create realistic and convincing videos in which the faces of famous actors were reconstructed with detailed facial features and seamlessly applied to the performers. The intention was for it to appear that the actors had played these roles without any sense of artificiality being conveyed to the audience.

I worked closely with Chelsea to test several popular Deepfake software and websites, aiming to find the most effective solutions for our project. We determined that DeepSwap.ai and DeepFaceLab were the most suitable for our needs. Unlike most other applications (apps) primarily designed for personal entertainment and lacking the ability to apply Deepfakes to user-specified videos, DeepSwap.ai and DeepFaceLab directly offered advanced functionalities. These apps allowed us to upload our own videos and integrate the Deepfake elements precisely, ensuring that the final product met our project's requirements. This capability was crucial as it provided the flexibility to use specific footage and seamlessly apply Deepfake technology. In contrast, other apps typically involved a more limited process: users would upload a photo of the face to be Deepfaked, the application would analyze the face and then apply the Deepfake to pre-existing videos within the application, offering less flexibility and precision.

DeepSwap.ai required multiple images of Danny DeVito from different angles to accurately map his facial features onto the performer in the video. The result was a face that blended Danny DeVito's appearance and the person in the video, with Danny DeVito's face not clearly recognizable. This result was undesirable because it failed to convincingly overlay Danny DeVito's face onto the performer, making the Deepfake less effective.

In contrast, during our initial tests and comparisons, DeepFaceLab delivered the most realistic and indistinguishable images among the tools we evaluated, even though it had some limitations. One major drawback was its intensive processing requirements, which made real-time performance impractical. The software relies on powerful hardware and extensive rendering time to accurately analyze and recreate facial features, limiting its use to pre-recorded videos. Creating professional deepfakes with DeepFaceLab also demanded significant effort—time was needed both to train the system on the facial features of famous actors and to compile a comprehensive set of prior videos showing them in various states and angles.

Since DeepFaceLab requires extensive computational power, it was essential to have a high-performance GPU capable of handling large-scale facial transformations. Fortunately, the university provided a workstation with the necessary specifications, significantly reducing our costs and removing hardware limitations.

With the required resources in place, Chelsea began working with DeepFaceLab on the workstation. Over the course of a few days, she created several test videos featuring Elvis Presley's face. However, we encountered a problem: when performers executed abrupt head rotations, the deepfake faces sometimes became misaligned. These rapid movements led to distorted facial overlays—especially in profile views—where the AI struggled to maintain proper alignment. Although this issue could be resolved through meticulous frame-by-frame editing (a process that demanded both expertise and time), advising performers to limit sudden head movements helped reduce the need for extensive post-production corrections. An example of this distortion can be seen in the Elvis Presley deepfake (see Fig. 4.1).

After sharing the test videos with the group and Ryan and considering the high quality and faithful resemblance to the original actor, we ultimately selected DeepFaceLab for our project.

4.8 The Process of Utilizing Hologram and Deepfake Technologies

The process required two actors, one portraying Danny DeVito and the other Elvis Presley, to perform all Marley and Ghost of Christmas Past scenes in front of a green screen. They wore costumes and specific hair designs as directed by the costume designer. An off-camera person helped the actors by reading Scrooge's lines at a consistent pace to help them time their own dialogues and reactions. However, since Scrooge's live dialogue timing was unpredictable, there was a risk of desynchronization, potentially causing a two- to three-second mismatch and overlapping dialogue during the performance. Initially, we planned to film the videos continuously. However, to prevent dialogue mismatches, Ryan opted to record each line or reaction separately for better timing control. For instance, when Marley spoke, whether it was a paragraph or a line, Ryan would stop recording at the end of that segment, making that segment into a separate video file. Similarly, Marley's reactions or silences in response to Scrooge's actions were captured in separate shots. As a result, Marley's performance for that scene was divided into 28 separate video files. The same method was applied to the Ghost of Christmas Past, resulting in 42 individual video clips Ryan intended to play these videos at precise moments during the performance to ensure that the pre-recorded responses were synchronized with Scrooge's live performance.

Although the idea of synchronizing the dialogues and playing the videos of Marley and the Ghost of Christmas Past at the right time was conceptually sound, its execution posed significant challenges. During playback, frequent cuts, visible interruptions, and occasional black

screens disrupted Scrooge's performance when videos ended. Additionally, the videos were not continuous, leading to inconsistencies in the posture and gaze of the actor from one video to the next.

In hindsight, consulting other group members and professional production technicians beforehand might have improved the outcome. However, because of the urgency to complete the project on a tight schedule, Ryan made the decision to aim for better timing control, which resulted in some unforeseen challenges, including issues with video continuity and synchronization.

After filming, Chelsea uploaded the video files to DeepFaceLab, supplying the software with high-quality images and footage of Elvis Presley and Danny DeVito. This allowed the AI to analyze their unique facial movements and features. After this step, she applied the generated images to the videos. The software seamlessly replaced the actors' faces with those of Elvis and Danny DeVito, matching their expressions and movements. Initially, the results were not perfect, so she spent time adjusting the final videos using the software's features, trying to align the facial composites with the original actors' head movements in the problematic video frames, which was the most time-consuming part of her process.

After making these adjustments, the finished videos were released. The final results were striking, Elvis Presley and Danny DeVito seamlessly replaced the original actors. Elvis's facial overlay appeared natural and convincing, with accurately replicated eye movements and expressions. His facial features blended well with the original actor's head, creating a highly believable effect. The subtleties of his iconic expressions were captured accurately, making the generated image appear almost lifelike. Similarly, Danny DeVito's face was integrated in a way

that maintained his unique expression. However, there were still minor flaws in the images where rapid head movements occurred, which required more time to correct.

I reviewed the results and discussed with Ryan whether these outcomes were acceptable. Given that these characters played ghostly roles in the play, we concluded that the imperfections resembled cinematic ghost effects, making the final product both convincing and satisfactory (Fig. 4.1, 4.2)

4.9 Uploading Videos to QLab Software

After completing the Deepfake phase, we assigned numbers and names to each video to align with the planned scenes of the performance. We then provided the stage manager with the name and exact timing of each video during the paper tech session (Table 2), which is a pre-production meeting where the technical aspects of the performance are thoroughly reviewed on paper. This allowed the stage manager to cue each video at the designated times, with the videos being operated by the projector technician. To manage and control the timing of the video broadcasts during the performance, the projector technician and I then uploaded and categorized the videos in the QLab software based on the assigned numbers and names. QLab is a powerful software for designing sound and video for live performances such as theatre, enabling the synchronization of lighting changes and video clips with specific lines from the script, thus creating a cohesive experience for the audience.

4.10 New Challenges with the Hologram projectors and Their Solutions

In mid-September 2023, after a significant delay since the initial order from China (see Table 3), the hologram projectors finally arrived at the university. This delay left us with little time for thorough testing and final adjustments before the rehearsals began.

Upon arrival, the technical team started setting up the system. The projectors came with their own proprietary software for displaying content and video playback. However, unlike QLab, which allows for the seamless organization of cues and sequential video playback, the provided software lacked these features. Consequently, we had to merge all 28 Marley videos into a single file to enable continuous playback. This merging altered the original cue list, requiring the stage manager to make corresponding adjustments.

During initial testing, further challenges emerged. The built-in speaker of the device was malfunctioning, as the video's sound was marred by significant noise and frequent interruptions. Despite the technicians' best efforts, this audio issue could not be resolved. Additionally, one of the projector units failed to synchronize with the others, leading to misaligned images that distorted the holographic display.

Given the proximity to the start of rehearsals, returning the equipment to the manufacturer was not feasible. Instead, the team devoted considerable time to troubleshooting the image misalignment, as even minor discrepancies caused noticeable visual distortions.

At the suggestion of a projector technician, we decided to extract the audio from the Marley videos and play it through a separate speaker connected to QLab. This process involved uploading the audio file to QLab and simultaneously triggering the playback of both the video in the hologram software and the audio in QLab to achieve synchronization. Although this method posed a risk of synchronization issues, even a one-second delay could cause a noticeable desynchronization, it was our only viable option.

During implementation, we encountered an additional challenge: the hologram software introduced a few seconds of delay with each video load, while the audio from QLab played

immediately. To address this, we assigned a dedicated operator who, after repeated attempts, mastered the timing of the video delay and successfully synchronized the audio and video playback.

4.11 Setup and Placement of Screen Projections

I used three university-provided projection screens as backdrops in three designated parts of the stage, representing the past, present, and future. These screens varied in size, and I decided to use the largest one, the CYC, measuring 67 feet in width and 27 feet 8 inches in height, at the upstage. A smaller screen, measuring 19 feet 8 inches in width and 15 feet in height, was placed in the middle of the stage, and the smallest projector screen, measuring 13 feet 6 inches in width and 10 feet in height, was designated for the downstage. I wanted the backdrop images to become progressively larger and wider as one moved up the stage, ensuring that the audience could have a sufficient view of the display details from a distance.

The rationale behind these design decisions was to create a visual progression that aligns with the thematic elements of the play and the journey of Scrooge in *A Seussified Christmas Carol*. In the play, Scrooge's world starts vast and full of potential in the past but becomes increasingly smaller and more constrained as he moves through his life, leading to the smallest and narrowest perspective of the future. After discussions with the creative team, we decided that placing the largest screen at the upstage to represent the past would symbolize the expansive and significant world that Scrooge once inhabited. The medium-sized screen in the middle stage represents the present, showing the current state of Scrooge's world as it transitions and diminishes. Finally, the smallest screen downstage, representing the future, reflects the narrow and constrained outlook of Scrooge's potential future.

There were four Epson projectors at the university. After consulting with the projector technician, we assigned two of them to the largest display, the CYC, to enhance its quality and brightness because of its significant distance from the audience. The other two projectors were used for the middle and bottom stage displays.

To prevent large shadows of the cast and crew from appearing on the screens, we opted for rear projection by positioning the projectors behind them. We used both short-throw and standard lenses and positioned each projector on the rear wall of the stage to project high-quality images onto the screens of the appropriate size. This was achieved by calculating the exact distance and height relative to each designated display screen for every projector.

After the initial setup, we conducted a series of tests to adjust and refine the image sizes on the projection screens. These initial tests involved projecting various images onto the screens to assess the alignment, clarity, and overall quality of the projections. During these tests, we paid particular attention to how the images interacted with the physical elements of the stage, such as the platforms and steps.

The first test revealed that the image on the upstage screen (CYC) was positioned so that the bottom of the image aligned with the surface of Platform 1. The picture was surrounded by a border at the top and by two legs on the sides. However, the top of Platform 1 and its side steps acted as the lower frame, which created an uneven lower border, and this did not meet the director's expectations.

To address Ryan's concern, we adjusted the side legs to narrow the image's width, ensuring that only the top of Platform 1, excluding the steps, served as the lower border. Consequently, the image height also had to be reduced to maintain the standard aspect ratio.

Although this adjustment did not match the image size I had originally planned, the reduction did not negatively impact the audience's view. Since the image was shown above Platform 1, the audience still had a clear view of the details.

4.12 The Process of Creating Screen Projections Content

During pre-production meetings, I initially presented my backdrop designs to Ryan. Incorporating his feedback and fresh ideas, I then created sketches of shops, houses, and various settings. After thorough consultation, we narrowed the selection down to 20 backdrop designs (see Fig. 5.1).

Next, I carefully reproduced the selected sketches in Photoshop. I meticulously adjusted elements—doors, windows, tables, and chairs—to ensure they were proportional to human figures and stage props. This alignment was crucial for achieving a cohesive visual environment that blended digital backgrounds with onstage elements. After adding color to the sketches, I imported the layered files into Adobe After Effects.

Given time constraints and limited professional support, I prioritized ensuring that each image effectively conveyed the intended location and message. While I aimed to create refined images that seamlessly blended virtual and real-world elements, achieving full integration within the available timeframe was not feasible.

In After Effects, I animated several elements: the gentle snowfall outside windows, the flickering candlelights, the curling smoke from chimneys, and the dancing flames in fireplaces. Once the animations were complete, I integrated transparent video layers featuring the Deepfaked Ghost of Christmas Past into the scenes. A similar process was used for Marley's face on the door knocker, where I applied special effects before exporting the final animations as MP4 files.

In total, I produced 20 animation files—some featuring images of the Ghost of Christmas Past and Marley. I then uploaded all the files into QLab software, naming and numbering them according to each setting. Finally, I verified these details with the stage manager to ensure everything was in place for the on-stage rehearsals, which commenced on September 28, 2023, at the University of Lethbridge Theatre.

4.13 Tech Challenges in On-Stage Rehearsals & Live Performance

At the outset of rehearsals, as we began testing the actors' performances alongside holographic images of Marley and the Ghost of Christmas Past, we identified several significant technical challenges that needed addressing.

One of the primary issues was the excessive intensity of both ambient and stage lighting. The bright spotlights often directly illuminated the projector screens, which caused the backdrop images to appear washed out and low in contrast. Although the lighting designer made several adjustments to mitigate the problem, clarity and sharpness were still lacking in certain scenes—especially when, in some cases, the lighting designer and director opted for brighter lighting to suit other aspects of the performance (see Fig. 6.9).

Another challenge involved managing the space required for the placement of screen projections. To maintain image quality and avoid interference, the area between the projectors and the screens had to remain clear. This necessity significantly restricted backstage space, making crew movement and prop handling more difficult. There were instances when crew members, while preparing props near the center of the stage, inadvertently cast brief shadows on the downstage screen, disrupting the display for a few seconds during the performance.

Despite these hurdles, the digital screens proved essential in facilitating rapid and smooth scene transitions. They not only constructed the Seussian world of the play and conveyed its narrative with visual clarity, but also minimized the need for extensive physical set changes. By projecting clear images of various locations that enhanced the play's distinctive surreal style, the screens ensured an uninterrupted flow that conserved both time and resources, eliminating time-consuming pauses.

A further technical concern was the operational noise of the hologram projectors, which ranged from 30 to 50 decibels. Although this noise level could potentially be distracting in a quiet environment, the dialogue and music during performances effectively masked it, minimizing its impact.

Synchronization issues arose between the pre-recorded videos of Marley and the Ghost of Christmas Past and Scrooge's live performance. Delays or mistimed responses, along with abrupt video cuts, created distracting playback jumps. To address these issues, we used a dissolve effect in Adobe Premiere between video cuts, along with a beam of light effect, to smooth transitions and enhance the ghostly atmosphere. Technicians even collaborated with the actor playing Scrooge to better synchronize Marley's video cues with his delivery. Although a minor delay in Marley's response occurred during one live performance, it was barely noticeable and did not disrupt the overall flow, allowing the interaction to retain the illusion of a natural, live conversation.

A particularly complex challenge arose with the Ghost of Christmas Past, whose video spanned multiple scenes. Our team innovated by extracting the ghost's images from its background and uploading the animations to QLab for continuous play. We then overlaid the transparent video onto animated backgrounds, allowing for separate adjustments. The projector

technician edited the ghost's videos so that each dialogue segment began precisely at the cue, while non-dialogue parts were looped to match Scrooge's pacing. Fade-in and fade-out effects were added to ensure smoother transitions. Even the pan scene, featuring Scrooge's walk home and Marley's face appearing on the door, required meticulous timing adjustments. By dividing the pan video into multiple cues and refining the edits, we successfully synchronized the timing.

These modifications resulted in numerous new cue lists, which our dedicated stage manager updated repeatedly. Through dedicated effort, all final adjustments and video edits were completed in the last week of rehearsals, ensuring a smooth debut for *A Seussified Christmas Carol on* October 11, 2023.

Based on my observations from opening day, the technical preparations largely met expectations. Marley's sudden digital appearance through holographic projectors in a dark corner of the stage introduced a striking visual element rarely seen in traditional stagecraft, capturing the audience's attention. Moreover, the special effects designed to create smooth transitions in the ghost videos subtly enhanced their eerie, supernatural presence.

4.14 Challenges in Advertising and Poster Design

Drawing a parallel to the technical challenges experienced during live rehearsals, the production's promotional strategy encountered its own set of obstacles. My initial design strategy was to utilize Deepfake technology and holographic projection to bring virtual images of famous actors to life on stage realistically and convincingly. The intention was to spark audience curiosity and attract fans of these iconic figures to the theatre by featuring faces like Elvis Presley and Danny DeVito in roles such as the Ghost of Christmas Past and Marley. Advertising the

virtual presence of Elvis Presley and Danny DeVito could create an exceptional and exciting experience for the audience.

However, decisions regarding poster design and social media promotion diminished the impact of these figures in drawing interest. Removing the names of Elvis Presley and Danny DeVito from all advertising materials and show posters limited the audience's awareness of their presence, effectively neutralizing the strategy of drawing viewers by highlighting these prominent actors (Figure 6.13). These decisions were likely made out of concern over personality rights and to prevent misleading the audience about the nature of these actors' presence, as they appeared through Deepfake images rather than in person. Nonetheless, we could have transparently informed audiences about the use of modern technologies in this performance, similar to holographic concerts featuring late singers, where audiences are aware of the type of presence and are still encouraged to buy tickets to see their beloved icons. Despite my efforts, incorporating these figures' names in the advertising was entirely declined.

Instead, the promotional strategy focused primarily on highlighting the technological aspects of the production. Beginning on October 5, 2023, and running through October 11 and 12, a publicity campaign was conducted on TikTok, Instagram, and Facebook via University of Lethbridge pages such as @ulethbridge and @ulethbridge-finearts. These posts highlighted the integration of Deepfake and hologram technologies in the production, with Assistant Director Kae Carter offering detailed explanations of these innovations. He shared insights into the project’s use of advanced technology, including hologram and projection techniques, and elaborated on how filmed actors were projected onto the stage to interact seamlessly with live performers.

Deepfake designer Chelsea White also contributed, detailing the Deepfake process. She described how the actors' facial images were modified and discussed the experimental nature of the technology, its impact on stage, and its potential for future projects, expressing her excitement about audience reactions. However, she did not mention the names of the famous actors.

The videos featured vibrant rehearsal scenes, that captured the whimsical nature of the production. They highlighted the unique aspects of the performance, including the cast and their dynamic interactions on stage. These posts provided insight into the stage atmosphere, featuring images of set designs, backdrops, and the overall stage setup to offer a comprehensive view of the production's visual elements.

The posts also depicted the technical team adjusting projections, working with the green screen, and fine-tuning other setup components The emphasis on new technologies in these promotional efforts proved to be an effective strategy to spark curiosity and engage potential viewers. This approach provided an opportunity to assess how informing audiences about the use of innovative technologies influenced their interest in attending the performance.

To assess the initial reactions and engagement generated by this strategy, I reviewed the comments on these posts. Although the number of comments was modest, they offered valuable insights. One commenter noted, "Cool! So many possibilities. I'm old now and wish this existed when I used to do stagework in the late 80s." Other comments conveyed curiosity and admiration, indicating that the technological emphasis successfully captured the interest of different generations.

Integrating emerging technologies into *A Seussified Christmas Carol* revealed both the promise and the challenges of merging digital innovation with live theatre. Building on the

technical explorations—from casting and Deepfake applications to hologram implementation and even subtle adjustments in poster design—the project navigated budget constraints, safety regulations, and synchronization hurdles. Despite these challenges, collaborative problem-solving and adaptive planning ensured that the final production maintained its creative vision and technical integrity. Ultimately, the experience underscores the importance of flexibility, meticulous planning, and teamwork in successfully blending traditional performance with advanced technology—a lesson that will undoubtedly inform future theatrical endeavors.

Chapter 5: Conclusion

This chapter brings together the key findings from the project, starting with an evaluation of audience engagement and technological impact observed in *A Seussified Christmas Carol*, followed by reflections and team feedback on the integration of digital tools. The initial sections provided insights into how holographic projections, Deepfake technology, and projection screens influenced the overall production and audience experience. Building on these observations, I then address the core research questions, discussing the opportunities, challenges, and future potential of emerging technologies in live theatre, and conclude with recommendations for further research and practice.

5.1 Evaluating Audience Engagement and Technological Impact in *A Seussified Christmas Carol*

To evaluate the impact of the technologies used in the production of *A Seussified Christmas Carol* on the audience experience, I began by observing audience reactions during all three performances, which took place from October 11 to 14, including a matinee on October 14. Responses were generally positive and enthusiastic, with notable excitement during the scene featuring the holographic display of Marley's ghost. Many attendees showed visible signs of surprise and interest, expressing their amazement through subtle exclamations and focused attention on the projection. Building on this response, ticket sales reached 60% capacity on the final day, which was encouraging given that the play was staged in October, well outside the traditional Christmas holiday season when holiday-themed shows typically attract larger audiences.

To further understand the audience's experience, I had informal conversations with a group of ten attendees between the ages of 20 and 40 to gather direct feedback. These discussions provided valuable insights into their perspectives on the strengths and weaknesses of the show and their overall experience. Given the production's tight timeline and my high workload, my supervisor and I decided not to apply for human ethics approval, though it was technically possible. Instead, I relied on these informal conversations to assess how the implemented technologies influenced their viewing experience. The questions and insights raised in these discussions are as follows:

- **What made you decide to attend this play?**

In speaking with a few audience members, I heard various reasons for attending. Some, including family and friends of the cast and crew, came to show their support. Others were drawn to the play's colorful, Dr. Seuss-inspired style and humor, which appealed especially to families with children.

The timing of the performance near Halloween brought an added sense of excitement, giving a seasonal twist to the well-known tale of *A Christmas Carol*. Some drama students and theatre enthusiasts from outside the university noted that the university promotions on platforms like TikTok, Facebook, and Instagram featuring virtual characters and innovative technologies such as Deepfake and holograms, piqued their interest and motivated them to attend.

- **What are your thoughts on the scene where the ghost of Jacob Marley appeared on stage? Did the use of a hologram enhance the impact of Marley's**

character? How did this production differ from other performances of *A Christmas Carol*?

In conversations with some audience members, various opinions came up about the ghostly appearance of Jacob Marley. Some viewers felt that Marley's holographic entrance created a surprising and engaging experience, adding a fresh and imaginative element to the scene. They saw this approach as one of the production's strengths.

Others, however, mentioned that after the initial excitement, Marley's image started to feel ordinary. They believed that if Marley's hologram had used more effects to emphasize his supernatural qualities and appeared larger and closer to the audience, it could have been more impactful.

Ultimately, some people felt that while holograms were a fascinating innovation, they could never replace the unique presence and emotion that a live actor brings to the stage. They preferred the traditional productions of *A Seussified Christmas Carol* but also appreciated the use of new technology to enhance performances—so long as it didn't overshadow live acting or stage design.

- **Did the actors portraying Marley and the Ghost of Christmas Past seem familiar to you? Did they remind you of well-known celebrities?**

Most of the few audience members I spoke with couldn't fully recognize the Deepfake faces on stage. Some familiar with the original performers noticed slight changes in their appearances but weren't certain who the new faces represented or why these changes had been made. After I explained that the Ghost of Christmas Past was Elvis Presley and Marley was

portrayed by Danny DeVito, a few mentioned that the Ghost of Christmas Past's face (Elvis Presley) looked somewhat familiar. However, they noted that without my explanation, they wouldn't have identified him as Elvis Presley, as his voice, appearance, and other traits did not resemble him. They also observed that because of the distance between the hologram projector and the audience seats, it was challenging to make out Marley's facial details clearly. Interestingly, some even mentioned that, even if Marley's face had been closer and clearer, they still wouldn't have recognized Danny DeVito, as they were not familiar with the actor.

- **If the names of famous actors like Elvis Presley and Danny DeVito were mentioned in the play's advertisements, would this influence your decision to attend?**

Some audience members said that well-known names might spark their curiosity, making the show more appealing and even encouraging them to attend with family or friends**.** Especially when a deceased artist like Elvis Presley is set to perform on stage, it would be highly exciting and captivating. Others felt that while these names could add some interest, they valued the quality, creativity, and content of the performance more, and were more interested in experiencing something distinctive and innovative in the show itself, so the names alone wouldn't greatly influence their decision.

- **What is your opinion on the digital backdrops used in the play? Did these backdrops have a positive or negative impact on your viewing experience?**

Audience members had differing perspectives on the digital backdrops used in the performance. Some felt that these backdrops added visual appeal and depth to the scenes, helping them connect more closely with the story's atmosphere. This group viewed the digital backdrops as a positive, enhancing element in the production. Others suggested that incorporating more real or physical elements alongside the digital backgrounds in certain scenes might have deepened audience engagement and made the production feel more natural and tangible.

- **Which type of theatre do you prefer? A performance that follows traditional methods, emphasizing classic elements and acting, or a show that incorporates modern technology and digital tools to add innovative visual effects to the experience?**

Based on audience responses, preferences varied widely. Some viewers admired the timeless charm and authenticity of traditional theatre, appreciating its focus on classic elements and the depth of live performance. Others preferred productions that incorporate modern technology, believing that digital enhancements and innovative visual effects add a fresh layer of excitement and engagement. However, the majority expressed that blending traditional elements with modern technology can create a more enriching and immersive experience. They emphasized that seamlessly integrating these technologies with live performance is crucial. In their view, emerging technologies should serve to complement and enhance the production, aiding in the effective delivery of its message and emotional impact. Otherwise, they risk becoming a distraction and diverting attention from the core narrative.

5.2 Reflections and Team Feedback on Technological Integration

To gain a thorough understanding of the impact of the technological tools used in *A Seussified Christmas Carol*, I collected feedback from a talkback session organized by the Theatre Arts Society. This session captured reflections from key production team members, highlighting their experiences and insights regarding the integration of innovative tools such as holographic projections. The team members shared their thoughts on the challenges they faced and their overall experiences. These reflections were recorded and published on the Theatre Arts Society's YouTube channel (@theatreartssociety1343), providing an opportunity for the team to voice their perspectives on the production.

For example, Ryan, the director, initially found the idea of blending traditional performance with modern technology a bit daunting. However, after being introduced to the tech elements, he began to see their potential. He explained, "When I was introduced to the tech elements by the designer, I realized there was potential for the actors to engage with the technology in meaningful ways ("A Suessified Christmas Carol Talkback"). He encouraged the cast to focus on physical theatre and clown work to develop an engaging and lively performance, ensuring the production maintained its vibrant energy alongside the digital elements.

Assistant Director Kade Carter reflected on the process of implementing the holographic projections, noting, "From the start of the process, seeing Chelsea's work with Deepfake technology was eye-opening. She explained how the AI training worked, and it was intriguing to observe. The moment when the hologram fans began to function and displayed the image of Maple was memorable, although initial setup challenges were present." He pointed out that while

the technology had its share of imperfections, the team worked diligently to integrate it effectively into the performance.

Maple Jackson, who played Jake Marley's role, shared his experience with pre-filming scenes against a green screen. "It was unlike anything I'd done before," he said, emphasizing the need for precise movements within the limited space to ensure the projections would align properly. George Crawford, who acted alongside these projections as The Scrooge role, mentioned the adjustments needed when transitioning from rehearsing with a live reader to performing with pre-recorded projections. "I even practiced at home to get the timing right," he noted, underscoring the adaptability required for the new approach.

Reflections and team feedback reveal that integrating innovative technologies in *A Seussified Christmas Carol* brought both significant challenges and rewarding breakthroughs. Although initial apprehensions and a steep learning curve, evidenced by the director's concerns and the technical hurdles noted by the assistant director, highlighted the complexity of merging traditional performance with modern digital tools, these challenges ultimately created a creative and adaptive atmosphere. The performers' ability to adjust their techniques, whether by rehearsing with pre-recorded projections or perfecting movements against a green screen, demonstrates the dedication and resilience required to navigate this new terrain. Based on these reflections, we can conclude that blending technology with live theatre drives artistic innovation and growth, opening up exciting new possibilities for both performers and audiences alike..

5.3 Evaluation of Practical Project and Addressing Research Questions

In this section, the core research questions are revisited by analyzing how emerging technologies impact theatre. This discussion highlights their effects on production quality, audience experience, the ability to attract larger audiences, and the future of live theatre.

1. **What emerging technologies can be utilized in theatre, and what new possibilities do they offer? Additionally, what are the limitations and challenges associated with these technologies?**

A Seussified Christmas Carol demonstrated that emerging technologies, such as holographic projections (the Holofan) and Deepfake, can be effectively integrated into theatrical performances. For instance, holograms brought Marley's ghost to life, adding supernatural depth, while Deepfake technology digitally reimagined famous actors' likenesses to creatively bridge past and present. Projection screens further enabled rapid scene changes, clarifying settings and reducing reliance on physical sets. These technologies allow for creative presentations that align with the designer's vision and the play's requirements.

In the following, I will examine the possibilities and challenges associated with these three emerging technologies.

- **Holofan: Possibilities and Challenges**

The Holofan, available in various sizes, can be creatively employed to portray ghosts, supernatural figures, and other imaginative visuals on stage. However, to achieve a strong visual impact, very specific conditions are required. To produce a vivid three-dimensional display, it is essential that ambient lighting remains low, and a black background is used. These conditions

enhance image quality and strengthen the illusion of depth. Despite its creative potential, the Holofan also presents challenges, including safety concerns due to rotating blades, limited viewing angles (optimal only from the front), and a noise level (30–50 decibels) that may distract during quiet scenes.

From a software standpoint, the Holofan lacks support for live cueing. Unlike advanced theatre software such as QLab, it cannot play videos triggered by live cues, and any delay in image display complicates synchronization with live action. During our project, technical faults and hardware malfunctions underscored the need for ample time for testing, repairs, or even returning the device to the manufacturer. Its fragility also means that moving it mid-performance could misalign images or cause failures that disrupt the production. Despite these challenges, with thorough preparation, the Holofan can produce captivating visual effects that enhance a performance.

- **Deepfake Technology: Innovative Engagement and Its Limitations**

Deepfake technology introduces an innovative approach to audience engagement by digitally recreating the likenesses of famous actors, enabling characters to appear even when performers are absent. This approach revitalizes classic stories and provides creative flexibility in casting. However, integrating Deepfake technology presents significant challenges. Achieving a seamless blend between digital faces and live performers requires advanced technical resources, including powerful computers, skilled technicians, and significant editing time, and often feels incomplete without corresponding voice modifications. I believe that it is necessary to align not only the visual features but also the voice, facial expressions, hairstyle, costume, and even the distinctive movements and mannerisms of the intended actor. Without these adjustments,

character recognition suffers, and the intended effect is diminished. Moreover, the ethical implications add another layer of complexity that must be carefully addressed. Thus, while Deepfake offers promising possibilities for live theatre, its successful integration demands thoughtful planning to balance visual appeal with technical and ethical considerations.

- **Projection Screens: Enhancing Scene Transitions**

Projection screens play a vital role by allowing rapid digital scene changes, reducing the need for physical set changes while enhancing visual depth. In productions where projection screens fully establish the location of each scene, precise alignment of digital images with on-stage décor—through careful attention to color, perspective, and scale, is essential. Equally important is managing lighting to blend digital and physical elements seamlessly.

Challenges include the space required for rear projection, potential restrictions on backstage movement, and the risk of unwanted shadows or diminished image quality if stage lighting is too bright.

Given these technical considerations, implementing such technologies is not only a matter of creativity but also of feasibility. In the *A Seussified Christmas Carol* project, resource availability played a critical role in overcoming budget limitations. Access to a high-performance computer for Deepfake processing, university-provided projection screens and projectors, and Holofan components made it possible to experiment with these technologies within the production's financial constraints. Without these resources, evaluating and implementing such innovations would have been far more difficult. The Holofan, Deepfake technology, and projection screens each enhance the visual and narrative dimensions of live theatre productions but also present significant challenges. Their integration demands careful planning, technical

expertise, and close collaboration among production teams to ensure safety, image quality, and audience engagement, all while managing budgetary constraints that may limit accessibility for smaller theatres.

2. **Do these technologies enhance the audience experience and the quality of theatrical productions?**

The integration of holographic projections, Deepfake technology, and projection screens in *A Seussified Christmas Carol* highlights both their potential and the challenges they present in live theatre. These innovations create new opportunities to engage audiences and enhance storytelling, but their effectiveness depends on careful implementation and seamless integration with traditional theatrical elements.

One key takeaway from audience feedback is that while modern technologies can introduce excitement and novelty to a production, viewers ultimately value the quality, creativity, and content of the performance more. Many expressed that technology should enhance rather than overshadow live acting and stagecraft. This suggests that if technological components feel disconnected from the performance, they risk becoming distractions rather than meaningful enhancements.

Hologram technology, for instance, played a significant role in bringing Marley's ghost to life as a three-dimensional illusion, captivating the audience and reinforcing the play’s supernatural theme. This effect created a visually immersive experience; however, some audience members felt that its impact was inconsistent throughout the performance. They noted that the fixed placement of the holographic projector and its distance from them reduced its effectiveness. Many preferred more dynamic visual effects that could heighten the ghostly illusion. This

highlights a crucial consideration: while holographic projections can elevate a production's visual appeal and audience engagement, their placement, scale, and integration must be carefully managed to maximize their theatrical impact.

Similarly, the use of Deepfake technology to superimpose the faces of well-known celebrities onto performers received notable reactions. While this technique successfully created lifelike portrayals of Danny DeVito and Elvis Presley, some audience members found it difficult to recognize the celebrities without prior familiarity with their likenesses. I believe this suggests that visual resemblance alone may not be sufficient; supporting elements such as voice modification and mannerism replication are essential to enhancing character recognition. For Deepfake technology to reach its full potential, a holistic approach incorporating auditory and performative elements is necessary to strengthen authenticity. A notable example of this approach is Tupac Shakur's holographic performance at Coachella in 2012, where animation and archival footage were meticulously combined to replicate his tattoos, jewelry, and body movements, creating the illusion of a live performance ("Coachella's Astonishing Tupac Shakur Hologram"). Although *A Seussified Christmas Carol* lacked the resources to implement such intricate modifications, even adjusting the performers' voices to match the celebrities could have significantly improved audience recognition. To determine the effectiveness of such enhancements, further research and testing would be necessary to evaluate Deepfake technology's full potential in theatre.

In addition to holograms and Deepfake effects, projection screens played a crucial role in maintaining the pacing of the performance. Unlike traditional set changes, which can sometimes interrupt the flow of a play, digital projections facilitated smooth and rapid scene transitions. This

ensured a seamless visual experience while conserving resources, ultimately contributing to the production's cohesion and energy.

However, while these technologies introduced new creative possibilities, they also brought technical challenges. Issues such as misalignment between audio and visuals, occasional equipment malfunctions, and complications with holographic elements created obstacles during rehearsals and performances. Without thorough technical preparation, these difficulties could negatively impact the overall production quality. Additionally, incorporating digital effects required the cast to make significant adjustments, demanding extensive rehearsal time to synchronize their movements and dialogue with the technology. While these adaptations encourage artistic innovation, they can also compromise performance quality if not executed with sufficient preparation and coordination.

3. Does the utilization of emerging technologies lead to attracting more audiences?

Analyzing the responses and audience feedback from the practical project, *A Seussified Christmas Carol*, shows that using new technologies in theatre can attract audiences, but the impact is complex.

The use of technologies like holographic projections and Deepfake added an interesting element that caught the attention of different audience groups. Informal feedback and online comments showed that many people were curious about the mix of modern technology with a traditional play. For example, drama students and theatre fans said they were interested in the promotional material featuring virtual characters, Deepfake technology, and special effects. This initial interest underscores that technological integration can be an effective way to attract those interested in creative live theatre, especially when used in promotional strategies.

However, while the initial interest created by these technologies is clear, it is not a regular promotional strategy for such shows. The effectiveness of such interest depends on how the technology is presented and integrated into the production. In many well-known hologram shows, such as the Whitney Houston hologram concert (″An Evening with Whitney″), the promotional focus is often on the celebrity figure rather than the holographic technology itself, even though audiences are aware that hologram technology will be used. This strategy can initially attract audiences who are drawn by the nostalgia and fame of the featured figure. Nevertheless, feedback indicates that the presence of technology alone is insufficient to maintain engagement or encourage repeat attendance. What ultimately matters is how these technologies are woven into the storytelling and performance.

Additionally**,** some audience members said that while famous, deceased figures like Elvis Presley from the past in the show could catch their attention and make them want to attend, they valued the creativity, quality, and immersive feel of the performance more. This shows that even though new technologies can increase initial interest, audiences still care more about a meaningful and complete experience.

Ticket sales from the last performance, which reached 60% capacity, give some idea of audience interest but do not show how many came because of the new technology or other innovative elements. To truly understand how these technologies affect audience motivation, more research is needed, such as surveys or polls from all attendees to find out why people came to the show. While new technology and targeted advertising can create initial interest, detailed data would help assess its role in keeping audiences engaged and encouraging them to return.

In conclusion, using new technologies can help attract audiences by creating interest and offering something different. However, their lasting impact depends on how well they fit into the story and the quality of the overall production. Technologies can be useful for drawing initial attention, but keeping audiences engaged needs a balance between these tools and the performance's artistic quality. Using technology to attract interest, along with ensuring good content, is key to maintaining audience interest and bringing them back.

4. How might emerging technologies shape the future of live theatre?

Emerging technologies are reshaping live theatre by introducing novel ways to engage audiences and redefine the performance experience. The trend toward incorporating tools such as holographic projections, Deepfake technology, and projection screens has already sparked interest among audiences, as seen in productions like *A Seussified Christmas Carol*, where these innovations drew attention from diverse demographics.

Several trends and predictions can be made about the long-term impacts of emerging technologies on live theatre. The trend toward incorporating digital technologies in theatre is likely to continue growing, driven by advancements in hardware and software capabilities. Projection mapping and projection-based augmentation, which involve overlaying digital images and animations onto real-world surfaces to create dynamic visual experiences, are expected to become more prevalent as projectors and related technologies become more sophisticated and accessible (Pike, "Make it so…"). These improvements will enable more complex and realistic visual effects, further blurring the line between the physical and digital realms.

Recent developments in projection mapping and augmentation have included the introduction of high-speed projectors capable of projecting at nearly 1,000 frames per second.

This advancement significantly enhances the precision of visual effects by minimizing latency and ensuring smooth motion, which is essential for aligning visuals with moving objects on stage. Techniques like geometric registration allow projectors to accurately map images onto non-planar or textured surfaces, ensuring seamless and correctly positioned visuals. Radiometric compensation adjusts projected colors to match the surface's texture and lighting, resulting in more vivid and accurate imagery. Additionally, defocus correction compensates for blurriness when projecting onto uneven surfaces, maintaining the sharpness and detail of images. Another notable development is the integration of AI-driven interactivity, which has opened the door to projection systems capable of responding in real time to performers' movements and audience interactions. This capability creates a more adaptive and engaging theatrical experience, immersing viewers in a hybrid digital-physical environment. Looking ahead, projection mapping is expected to evolve beyond visual augmentation by incorporating sensory feedback mechanisms that engage multiple senses, such as touch and temperature. These advancements aim to deepen audience immersion by making digital experiences feel more tangible and interactive. Additionally, the refinement of perceptual realism seeks to enhance the fidelity of projected images, making them indistinguishable from real-world objects and environments, ultimately bridging the gap between the virtual and the physical. (Iwai).

As augmented reality (AR) and virtual reality (VR) technologies become more user-friendly and affordable, their application in live theatre is also expected to increase (Pike, "Make it so…"). These tools offer the potential for creating more interactive and immersive productions, which could help attract a broader audience, including younger generations who are accustomed to digital forms of entertainment.

A noteworthy trend in this domain is the convergence of live and digital experiences. Technologies such as the Future Cast System, which allows audiences to become part of a film by integrating their computer-generated (CG) avatars into pre-recorded movies offer a glimpse into this future. By enabling real-time participation, this technology provides a unique experience where audience members can see themselves alongside famous actors and partake in the movie's narrative. Utilizing advanced technologies such as 3D scanners, real-time character generation, and robust rendering systems, the Future Cast System represents a significant technological advancement in visual entertainment (Maejima et al.). Although primarily designed for movie theatres, the application of projectors and digital mediums in theatre indicates that such innovations could profoundly impact live theatre as well, creating more interactive and engaging experiences for theatre audiences.

Rather than replacing live performers or undermining their specialized skills, emerging technologies are expected to enhance the craft, allowing actors to elevate their art through the use of digital tools. Dr. Shane Pike, Lecturer in Performance Studies at Queensland University of Technology, states:

> I do not see a future where live performance is replaced with entirely projected, pre-animated holograms. There will always be the want and the need for live bodies in the space – even if those bodies occupy a different space and are transmitted in real time – as this is fundamental to the rite and ritual that is the theatre (Pike, “Make it so…”113).

The long-term impacts of emerging technologies on live theatre are profound. These technologies are not only redefining methods of storytelling and audience engagement but also setting the stage for a new era of theatrical innovation. Institutions like the Virtual Theatricality

Lab (VTL) at Henry Ford Community College in Dearborn, Michigan, exemplify the forefront of this technological integration, combining artistic and technological disciplines to produce cutting-edge performances (Popovich). Similarly, the University of Lethbridge integrates digital technology into its drama and New Media programs (Drama - Performance (BFA)*;* New Media), equipping students to adapt to modern advancements. By incorporating such technologies into theatre education, these institutions prepare future theatre artists with essential skills for the evolving landscape. This focus on combining artistic creativity with technological proficiency is crucial for the next generation of theatre professionals.

5.4 Recommendations Based on My Experiences

Innovative theatre projects, especially those incorporating emerging technologies, present various challenges and opportunities. To effectively integrate these technologies and ensure the success of future theatre endeavors at the University of Lethbridge and beyond, I offer several key recommendations based on my experiences in this production.

One critical area for future research is the development of more cost-effective alternatives to expensive technologies. For instance, exploring low-cost hologram projectors or alternative projection methods could provide similar visual effects without the high financial burden. Making these technologies more accessible would allow theatre practitioners to experiment and innovate without being constrained by budget limitations.

The technical challenges I experienced in this project underscore the necessity of thorough examination and initial testing of emerging technologies before the pre-production stage. Each new technology should be tested separately under real performance conditions to ensure optimal performance and alignment with project goals. These tests should include technical, visual, and artistic reviews to identify and resolve potential issues before

implementation. Allocating sufficient time for research and development in innovative projects is also crucial. Project timelines must account for potential delays, ensuring that all technical and artistic aspects can be properly implemented without compromising quality.

Consistent and dedicated technical support is another essential factor in the success of theatre productions utilizing complex technologies. In *A Seussified Christmas Carol*, only one technician was responsible for projections while also managing other areas such as sound. This heavy workload often made him unavailable, leading to stress and operational challenges. To prevent such issues, I recommend assigning at least two technicians to each key technical role throughout the project, from rehearsals and pre-production to live performances. This redundancy would allow for quicker troubleshooting and ensure smoother production workflows.

5.5 Conclusion

This practical project explored the integration of emerging technologies in live theatre, demonstrating both their potential and their challenges. Through *A Seussified Christmas Carol*, key insights were gained into the use of holographic projections, Deepfake technology, and digital projections as tools for enhancing theatrical storytelling. While these technologies expanded creative possibilities, they also presented technical limitations, ethical considerations, and logistical hurdles.

One of the most significant findings of this project was the feasibility of using holographic and Deepfake technologies to create virtual representations of both deceased and living actors. This approach allowed for dynamic interactions between digital and live performers, offering new dimensions to theatrical experiences. However, the process highlighted several challenges, including technical constraints, high costs, and the need for extensive

expertise in both technology and performance. These factors emphasize the importance of strategic planning and resource allocation when integrating such tools into live productions.

Audience feedback, though gathered from a limited sample, generally indicated a positive response to the visual enhancements and the integration of digital projections introduced through these technologies. However, given the relatively small sample size, broader studies involving larger and more diverse audiences are necessary to fully assess the impact of digital integrations on theatre engagement. Future projects should prioritize audience research to refine technological applications and enhance their effectiveness in live performances.

Importantly, this project reaffirmed that while technology can enhance theatrical productions, it should not overshadow the fundamental qualities that define live theatre—authenticity, presence, and human connection. The success of technological integration depends not only on its novelty but also on its ability to support storytelling and deepen audience engagement.

From a broader perspective, this project underscores the importance of balancing innovation with artistic integrity. Theatre's evolution should embrace emerging technologies while preserving its role as a space for reflection, emotion, and shared experiences. Future research should continue exploring best practices for integrating digital tools in a way that complements rather than replaces traditional theatrical elements.

Ultimately, the findings suggest that the future of theatre lies in the seamless blending of technological advancements with conventional practices. Custom-designed, theatre-specific applications can help minimize technical disruptions and ensure a more immersive experience.

Thoughtful and deliberate integration of these tools will play a crucial role in shaping a dynamic and sustainable future for live theatre.

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Appendix A: Technical Details of *A Seussified Christmas Carol*

Table 1: Special Effects Equipment

Item	Quantity	Model	Size	Details	In Stock (At the U of L) / Purchase	Functions
Hologram Projector	1	3D Holographic Human SH-F80 Solution	80cm*191cm	Resolution:928Px2240P	Should be purchased	Using to bring the video of the actor playing ghosts on the stage.
EPSON Projector	4	Epson Pro G6900WU Projector	-	1920x1200 3LCD, 6,000 lumens, 5,000:1 contrast, 1.82:1 zoom, 21.5 lb Lens requirement: -One Standard -Three Epson Short Zoom ELPLU01	In Stock	Using to display the backdrops images of settings on each screen
Cyc/PR Screen	1	-	65'W * 27'8"H	plastic, pipe in pipe pocket across bottom	In Stock	Upstage
Small RP Screen	1	-	19'-8"W * 15'-0"H	Plastic PVC, grommets all 4 sides, pipe across bottom	In Stock	Middle stage
TBD	1	-	13'-6"W * 10'-0"H*	Snaps to frame	In Stock	Downstage
Snow Bag	1	-	48’W x 3’-7” (when doubled over)	-Mostly fabric with 1’8” high mesh section at the top of one side Mesh is 3/8” x 3/8” squares	In Stock	Using in the final scene. The snow should be the full length of the snow bag.
Christmas Lights	85’ string light	-	White string lights	-	In Stock	Using in the street & final scenes

Table 2: Projection Images Cues

Cue #	Cue Name/ Line	Pg. #	Screen	Projector#
1	Scrooge's office door	8	DS Screen	4
1.5	Fade and stop scrooge's office door	9	DS Screen	4
2	Scrooge's office	9	CS Screen	3
3	Fade out scrooge's office and fade in pan	14	CS Screen	3
3.3	Pan	14	DS Screen	4
3.5	Pan face appears	14	DS Screen	4
4	Pan face speaks	15	DS Screen	4
4.5	Fade and stop pan	15	DS Screen	4
5	Scrooge's bedroom	15	CS Screen	3
H1	Hologram	15	HOLOFAN	-
7	Ghost of Christmas past	20	CS Screen	3
7.1	Hey look	20	CS Screen	3
7.2	I am the ghost of x mas	20	CS Screen	3
7.3	I thought as much so I brought this	20	CS Screen	3
7.4	It's an anti gravity spray	20	CS Screen	3
7.5	Fine have it your way	21	CS Screen	3
8	Country lane 1	21	US Screen	1,2
8.1	The ghost appears	21	US Screen	1,2
8.2	Chicks dig a car	21	US Screen	1,2
8.3	We've come to the place	21	US Screen	1,2
8.4	They were a band	21	US Screen	1,2

8.5	We ‘re back in time	21	US Screen	1,2
8.6	Think back	21	US Screen	1,2
9	Schoolhouse	22	US Screen	1,2
9.1	You were unpopular	22	US Screen	1,2
9.2	Good hair is important	22	US Screen	1,2
9.3	Here takes my hand	22	US Screen	1,2
9.4	The others for xmans	22	US Screen	1,2
9.5	Your sister was delicate	24	US Screen	1,2
9.6	Well, giddyup	24	US Screen	1,2
10	Fezziwig’s party	24	US Screen	1,2
10.1	Add ghost	24	US Screen	1,2
10.2	You played for the xmas dance	24	US Screen	1,2
10.3	Who’s that dancing with her	24	US Screen	1,2
10.4	Smell it from here	24	US Screen	1,2
10.5	Well, it’s nice that fezziwig	25	US Screen	1,2
10.6	So, no small task then	26	US Screen	1,2
10.7	Hey, look what the young you’s doing	26	US Screen	1,2
10.8	Let’s fast forward a skosh	27	US Screen	1,2
11	Country lane 2	27	US Screen	1,2
11.5	Add ghost	27	US Screen	1,2
11.6	Ouch, that was harsh	28	US Screen	1,2
11.7	Just one more glimpse	28	US Screen	1,2
12	Belle’s House	28	US Screen	1,2
12.1	This might not be all of them	28	US Screen	1,2

12.2	Don't blame me	28	US Screen	1,2
12.3	Finger snap	29	US Screen	1,2
12.6	Fade and stop Belle's house	29	US Screen	1,2
13	Scrooge's bedroom	32	CS Screen	3
14	Cratchit's house door	33	DS Screen	4
14.5	Fade and stop Cratchit's house door	33	DS Screen	4
15	Cratchit's house present	33	CS Screen	3
16	lighthouse	36	CS Screen	3
17	Sea	37	CS Screen	3
18	Fred's House	37	CS Screen	3
20	Scrooge's House door	40	DS Screen	4
21	Cratchit's House Future	43	DS Screen	4
22	Graveyard	45	DS Screen	4
23	Scrooge's house door	46	DS Screen	4
24	Fred's house door	48	DS Screen	4
24.5	Fade and stop Fred's house door	48	DS Screen	4
25	Fred's House	48	CS Screen	3
26	Scrooge's Office	49	CS Screen	3
27	Door 1	50	CS Screen	3
28	Door 2	50	CS Screen	3
29	Door 3	50	CS Screen	3
29.5	Scrooge's office	50	CS Screen	3
30	Fade and stop scrooge's office	51	CS Screen	3
31	Background snow falling	52	-	-
32	FIN text	52	US Screen	1,2

Table 3: Key Production Timeline for *A Seussified Christmas Carol*

Date	**Key Event**
4 November 2022	Idea proposal submitted
5 December 2022	Selection of *A Seussified Christmas Carol* play
10 April 2023	Creative team meetings commenced
17 April 2023	Casting completed
1 May 2023	Preliminary set design shared
19 May 2023	Preliminary costing meeting held
10 July 2023	Set building started
19 July 2023	Image permissions obtained for Danny DeVito and Elvis Presley
1 August 2023	Digital backdrops design process initiated
20 August 2023	Holofan ordered
30 August 2023	Rehearsals started
30 August - 1 September 2023	Actor filming sessions conducted
12 September 2023	Holofan received
18 September 2023	Paper tech meeting
18-22 September 2023	Set installation completed
20 September 2023	Footage received for the Ghost of Christmas Past
25 September 2023	Footage received for Marley
24-28 September 2023	Projectors installed and focused; footage input into QLab software
28 September 2023	On-stage rehearsals commenced
2-5 October 2023	Technical rehearsals
9 October 2023	Set painting completed
11-14 October 2023	Performances
21 November 2023	Post-production meeting

Table 4: Estimated and Actual Costs for *A Seussified Christmas Carol*

Category	Item/Description	Budget (CAD)	Actual Cost (CAD)
Stage	Materials and construction	$414.00	$409.00
Properties	Props	$500.00	$433.00
Scenery	Set design, construction, and hologram projectors (Hologram projectors budget: $2,000 CAD, including shipping and additional hardware)	$3,613.00	$2,963.00

Appendix B: Trends in Performing Arts Attendance

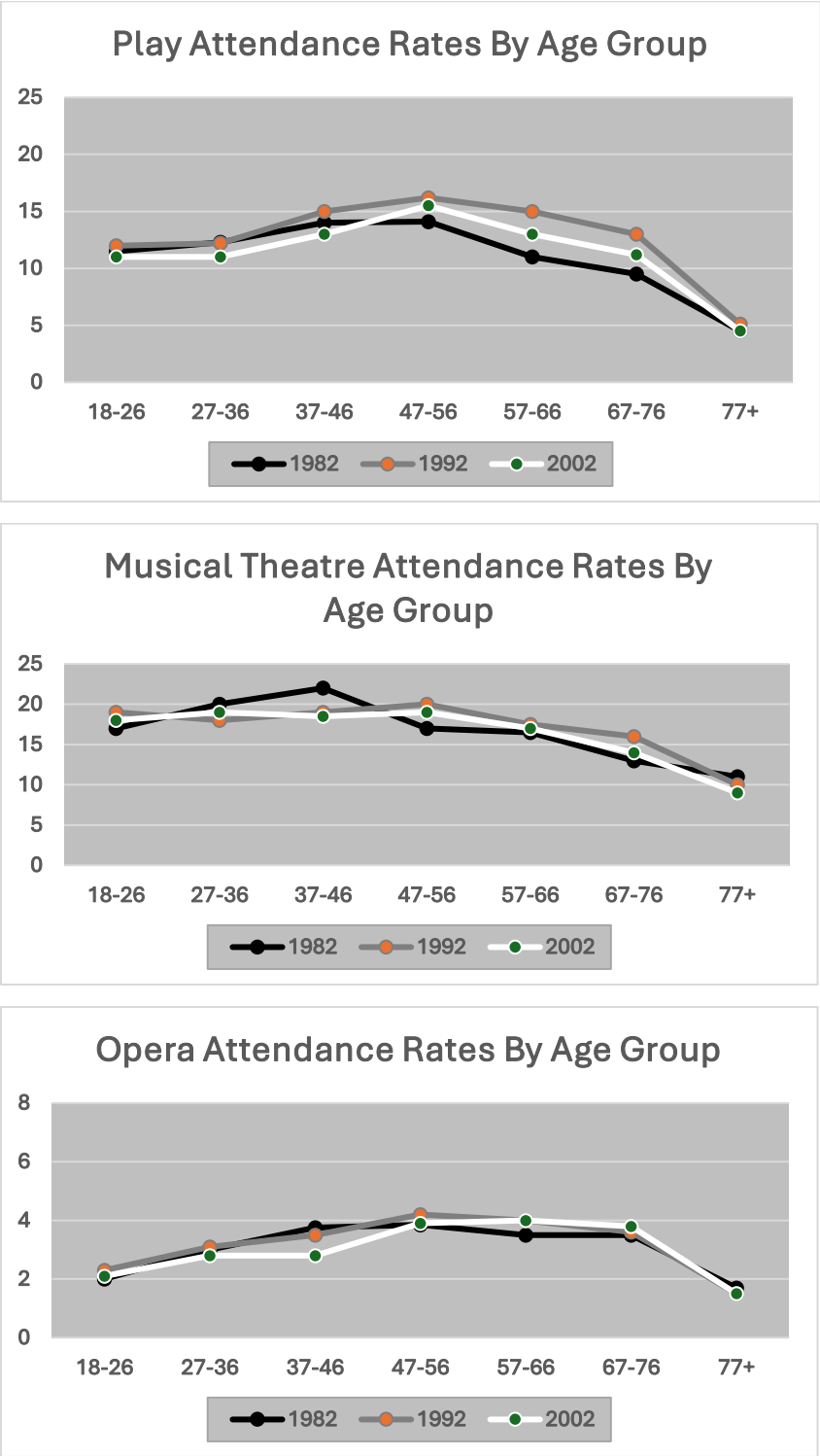
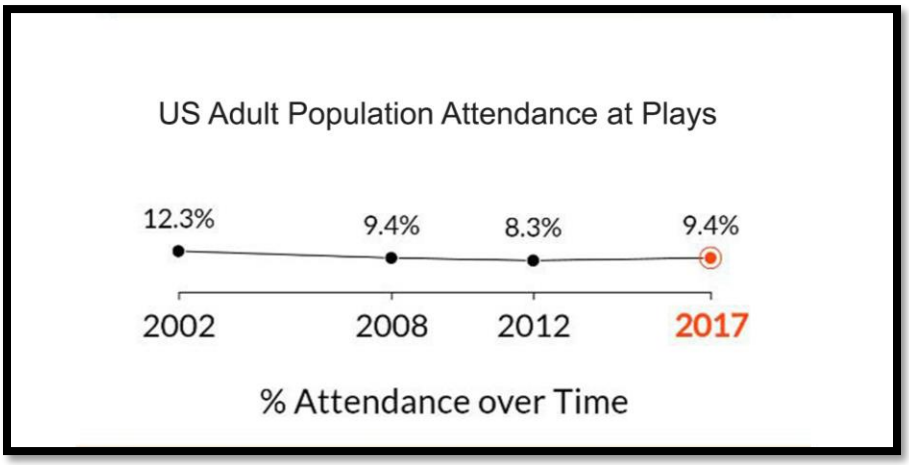
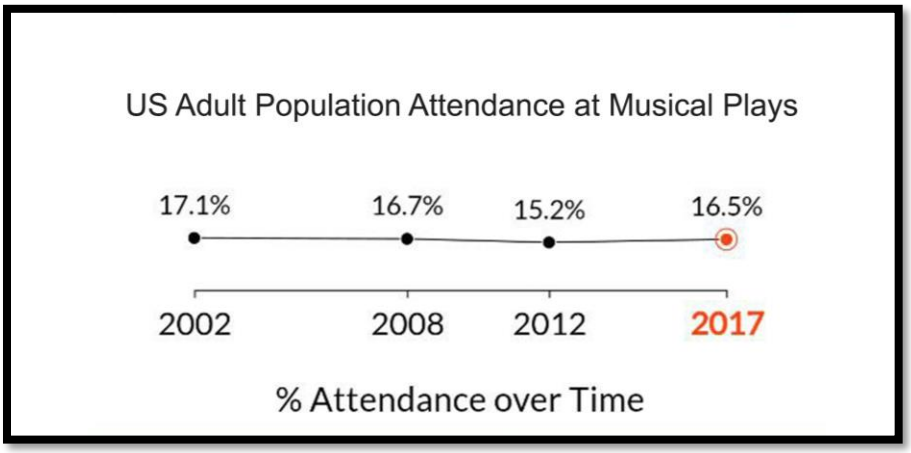


Fig.1.1. DiMaggio, Paul, and Toqir Mukhtar. *Play, Musical, and Opera Attendance Rates in the United States (1982-2002)*. Poetics, 2004.





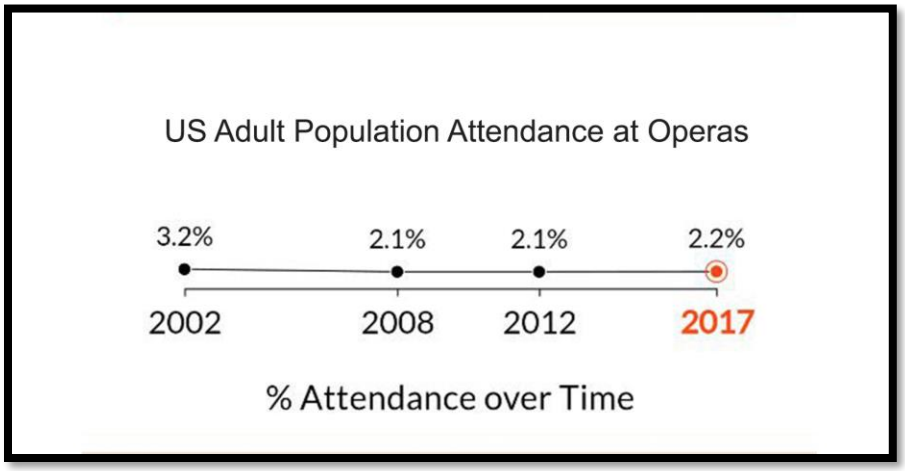


Fig.1.2. "U.S. Trends in Arts Attendance and Literary Reading: 2002-2017." *The United States Trends in Play, Musical, and Opera Attendance.* National Endowment for the Arts.

Appendix C: Design Sketches and Works in Progress

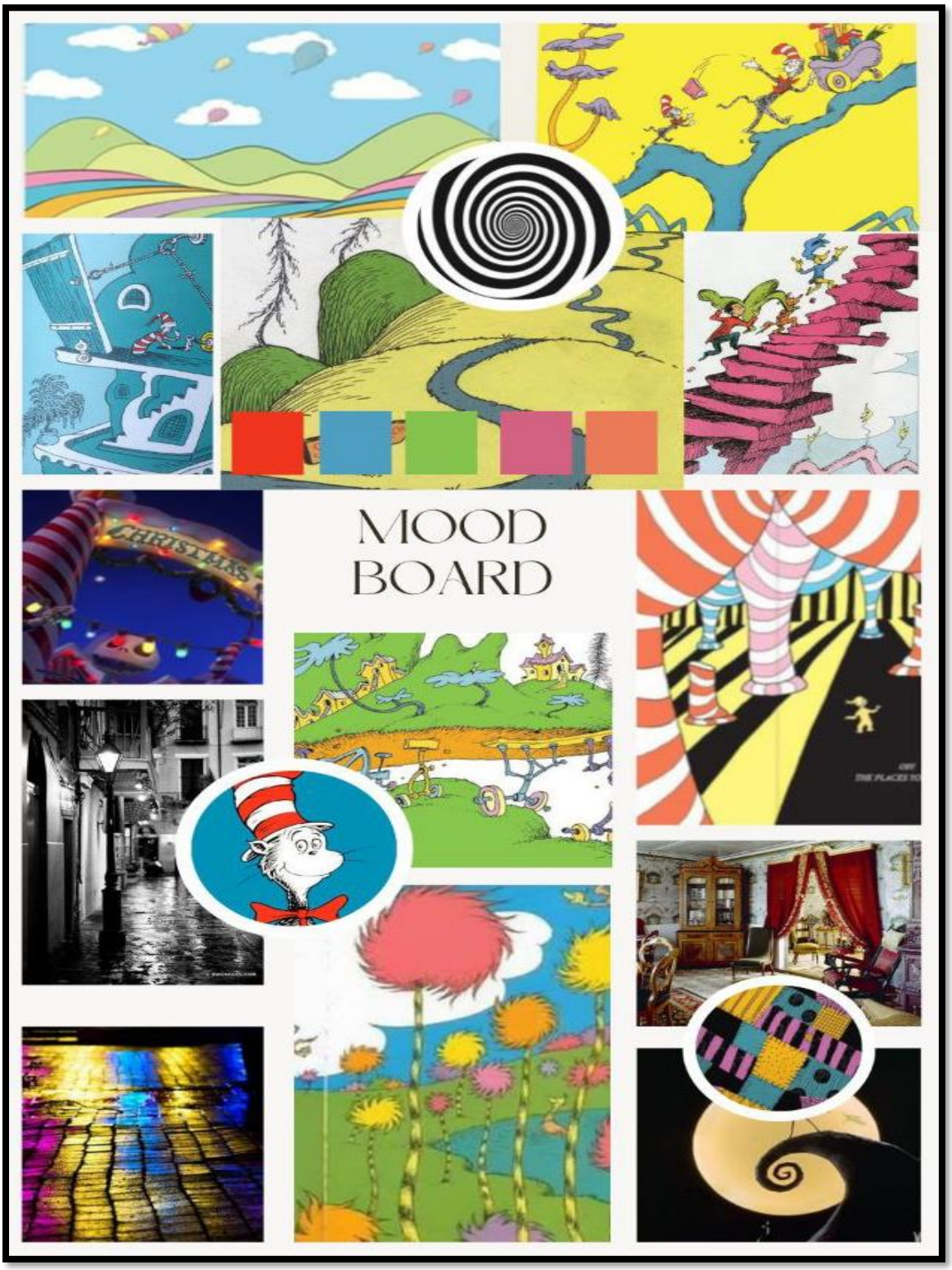


Fig. 2.1. Author's Collection. *Mood Board.* 2023.

Fig. 2.2. Barton, Jim. *A traditional iron seat dated 1897*. Geograph, 2011.

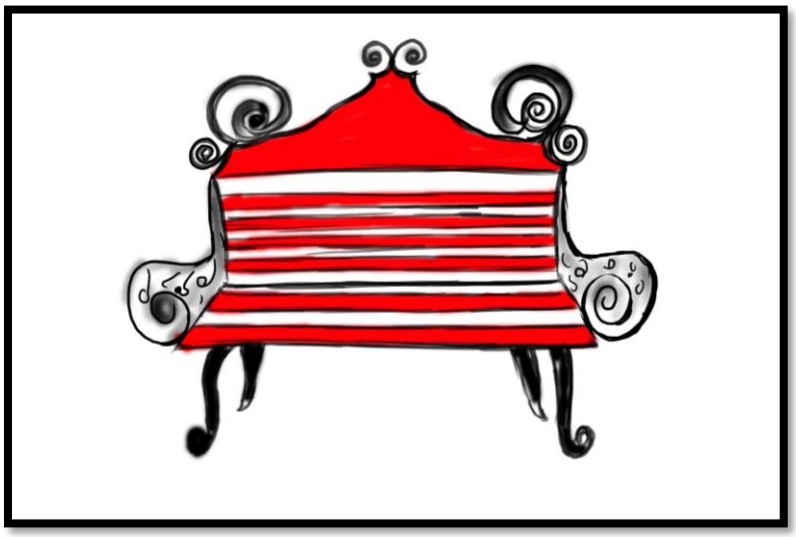


Fig. 2.3. Author's Collection. *Seussian Bench Design Inspired 19th Century Victorian Style.* 2023.

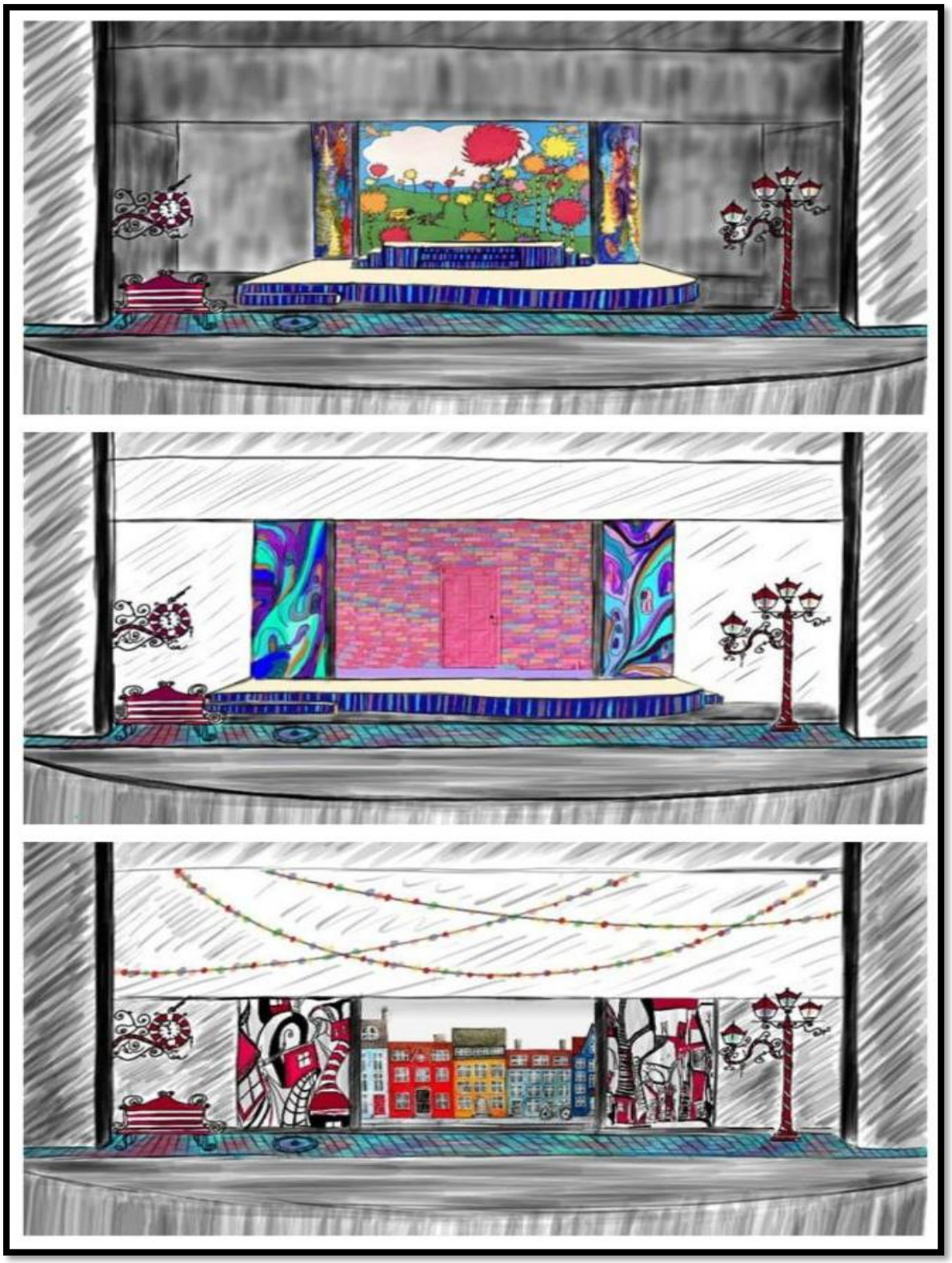


Fig. 2.4. Author's Collection. *Preliminary Set Sketches.* 2023.

Fig. 2.5. Author's Collection. *Physical Model.* 2023.

Fig. 2.6. Author's Collection. *Physical Model.* 2023.

Fig. 2.7. Author's Collection. *Physical Model.* 2023.

Fig. 2.8. Author's Collection. *Painted Panels.* 2023.

Appendix D: Ground Plans, Section Views and Elevations

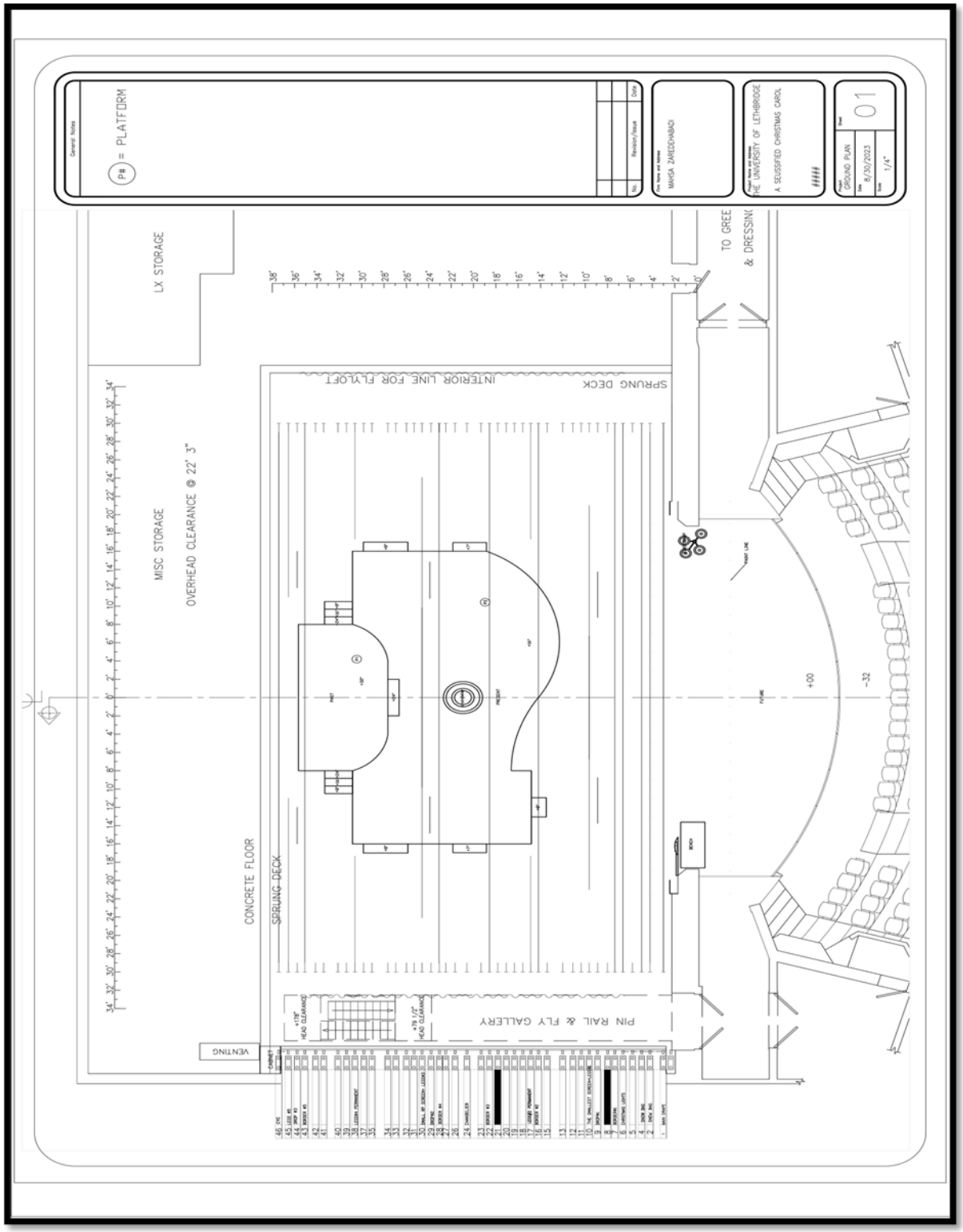


Fig. 3.1. Author's Collection. *Ground Plan.* 2023.

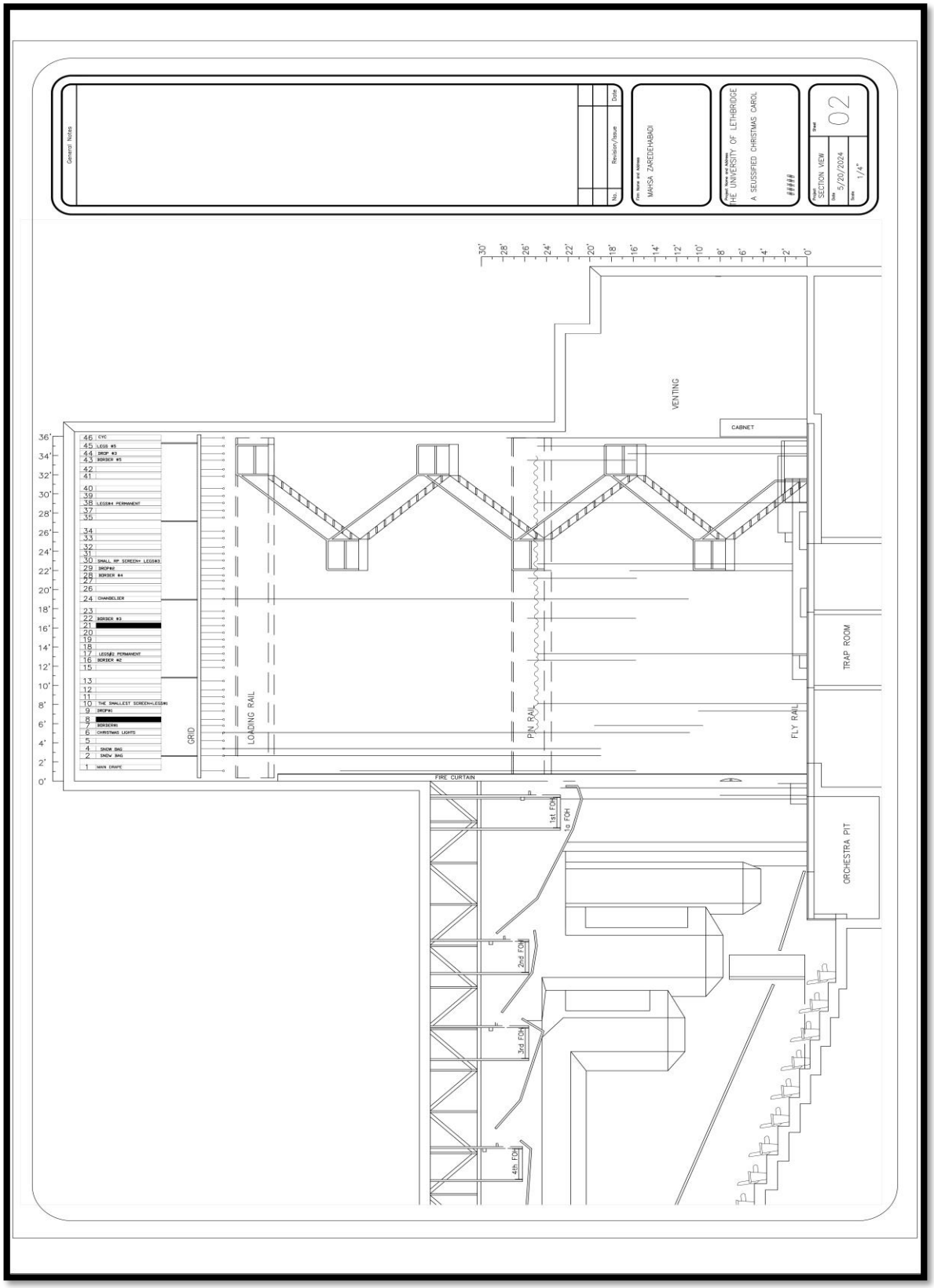


Fig. 3.2. Author's Collection. *Section View.* 2023.

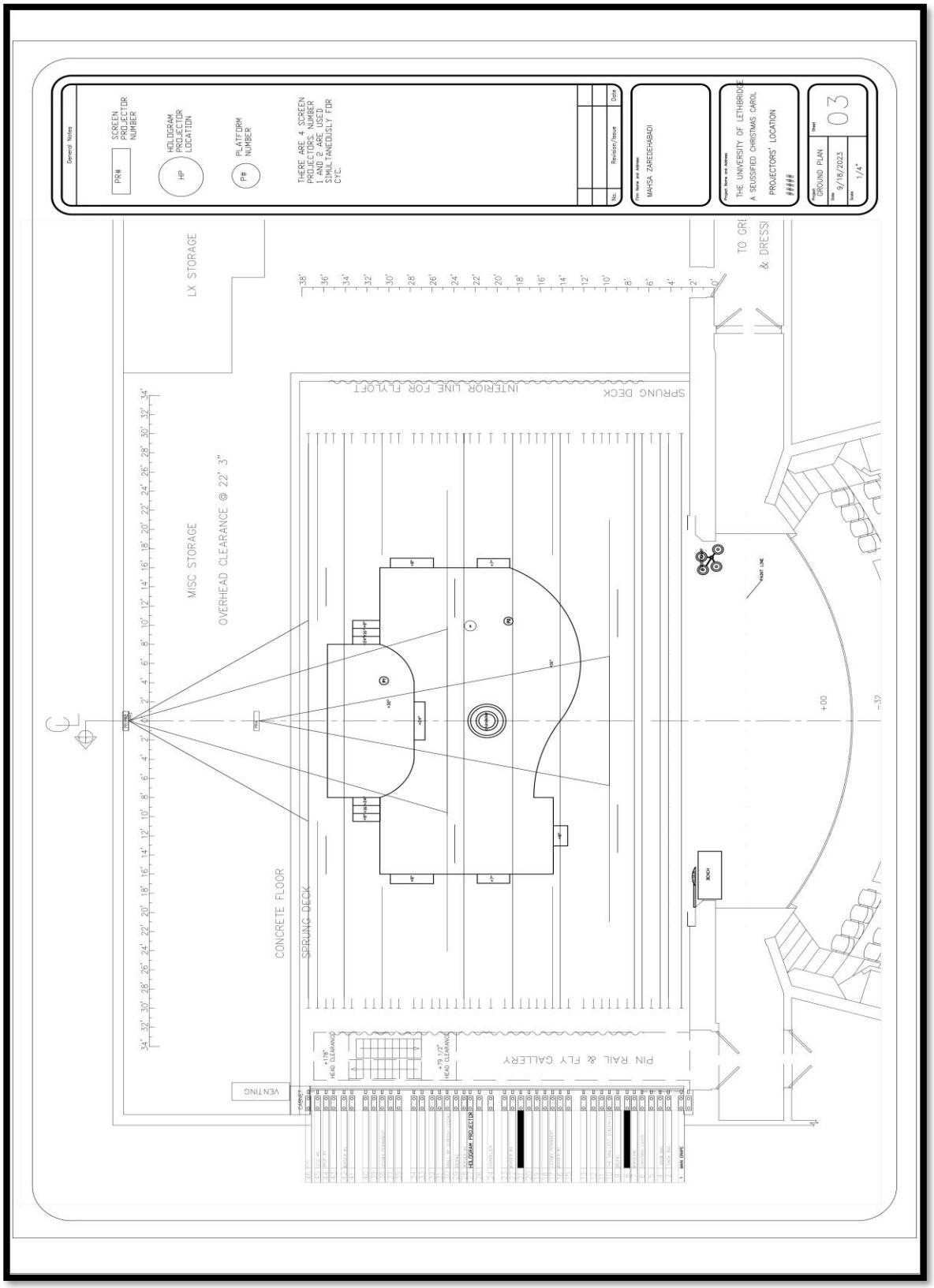


Fig. 3.3. Author's Collection. *Projectors' Location.* 2023.

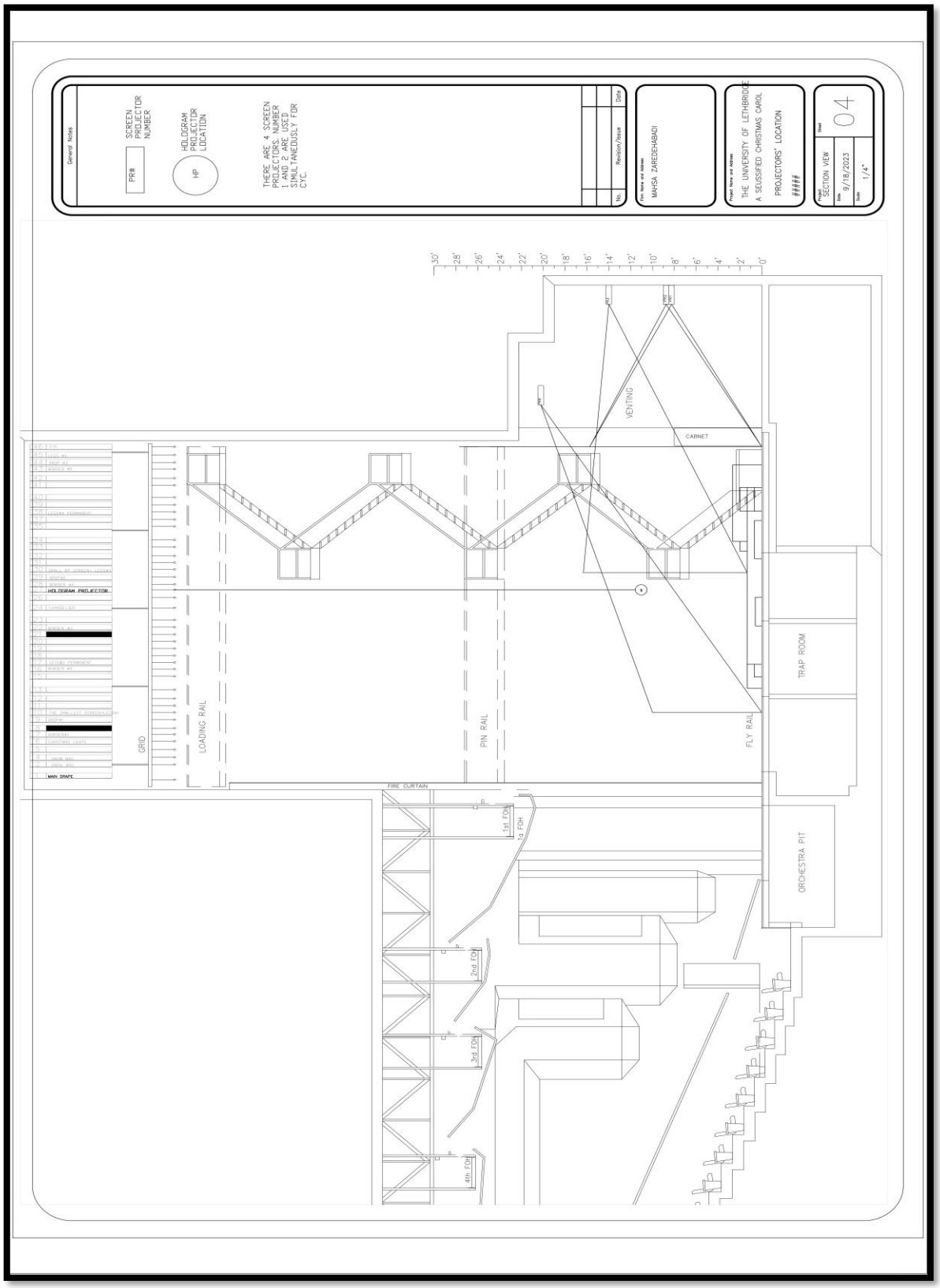


Fig. 3.4. Author's Collection. *Projectors' Location.* 2023.

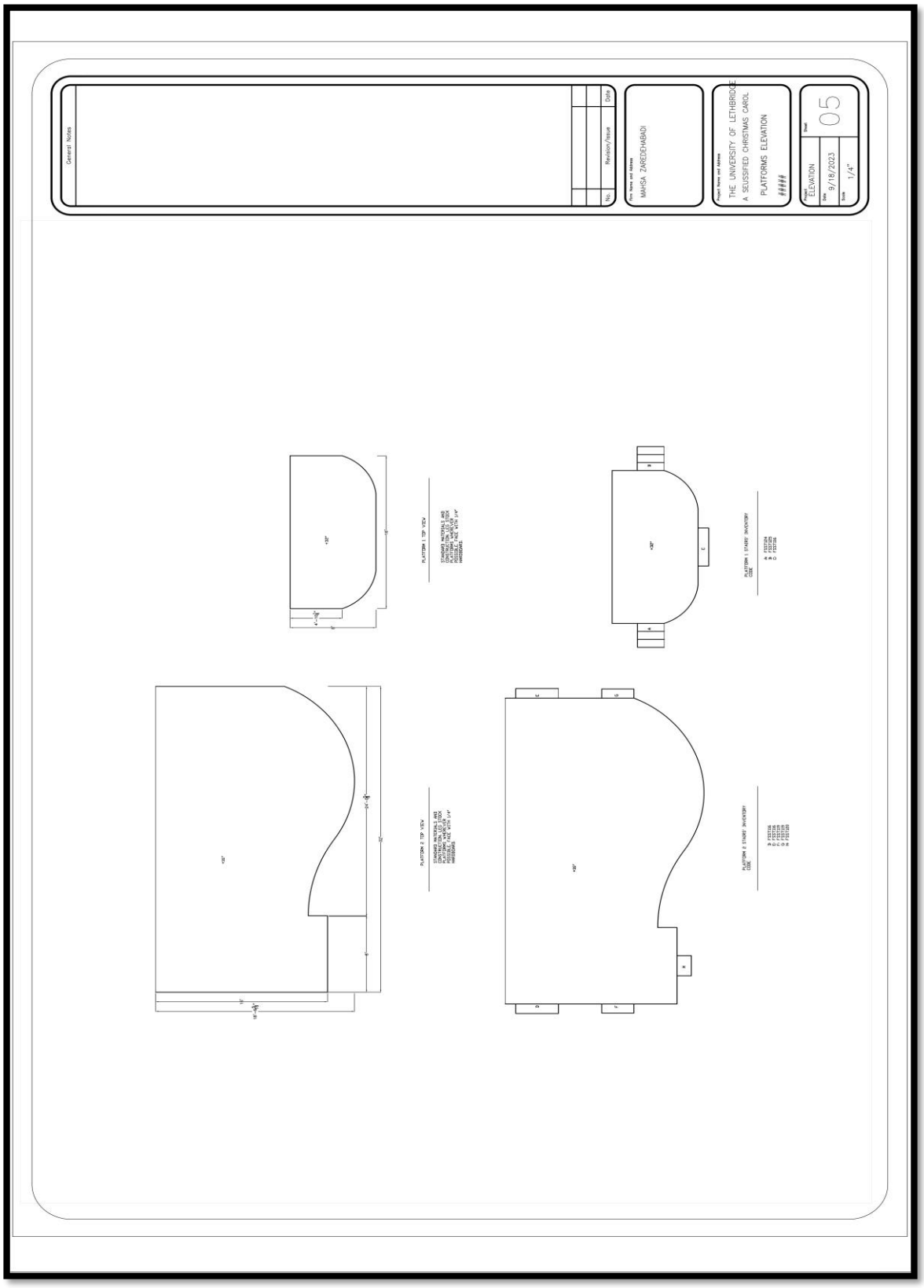


Fig. 3.5. Author's Collection. *Platforms Elevation.* 2023.

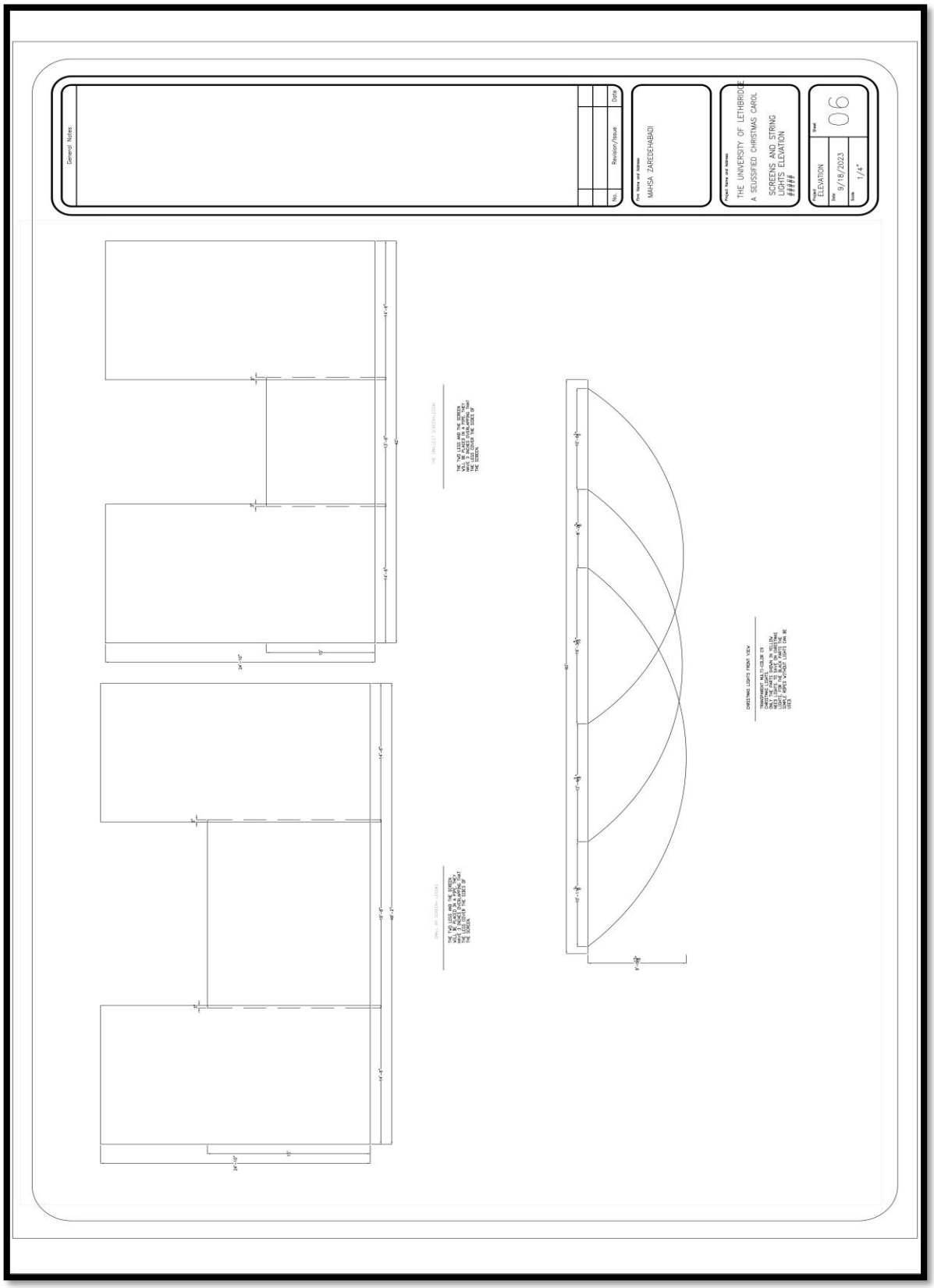


Fig. 3.6. Author's Collection. *Screen and String Lights Elevation*. 2023.

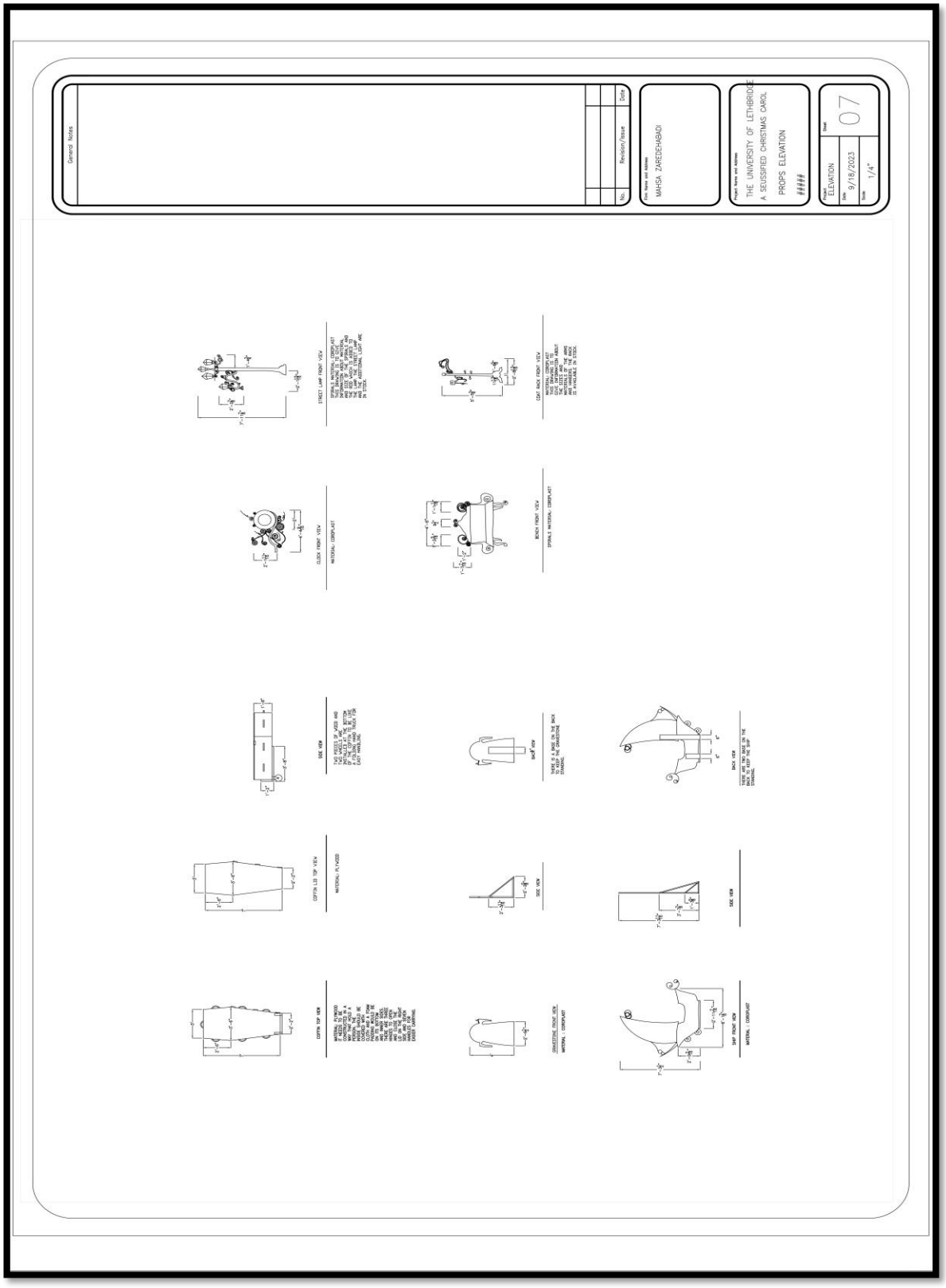


Fig. 3.7. Author's Collection. *Props Elevation*. 2023.

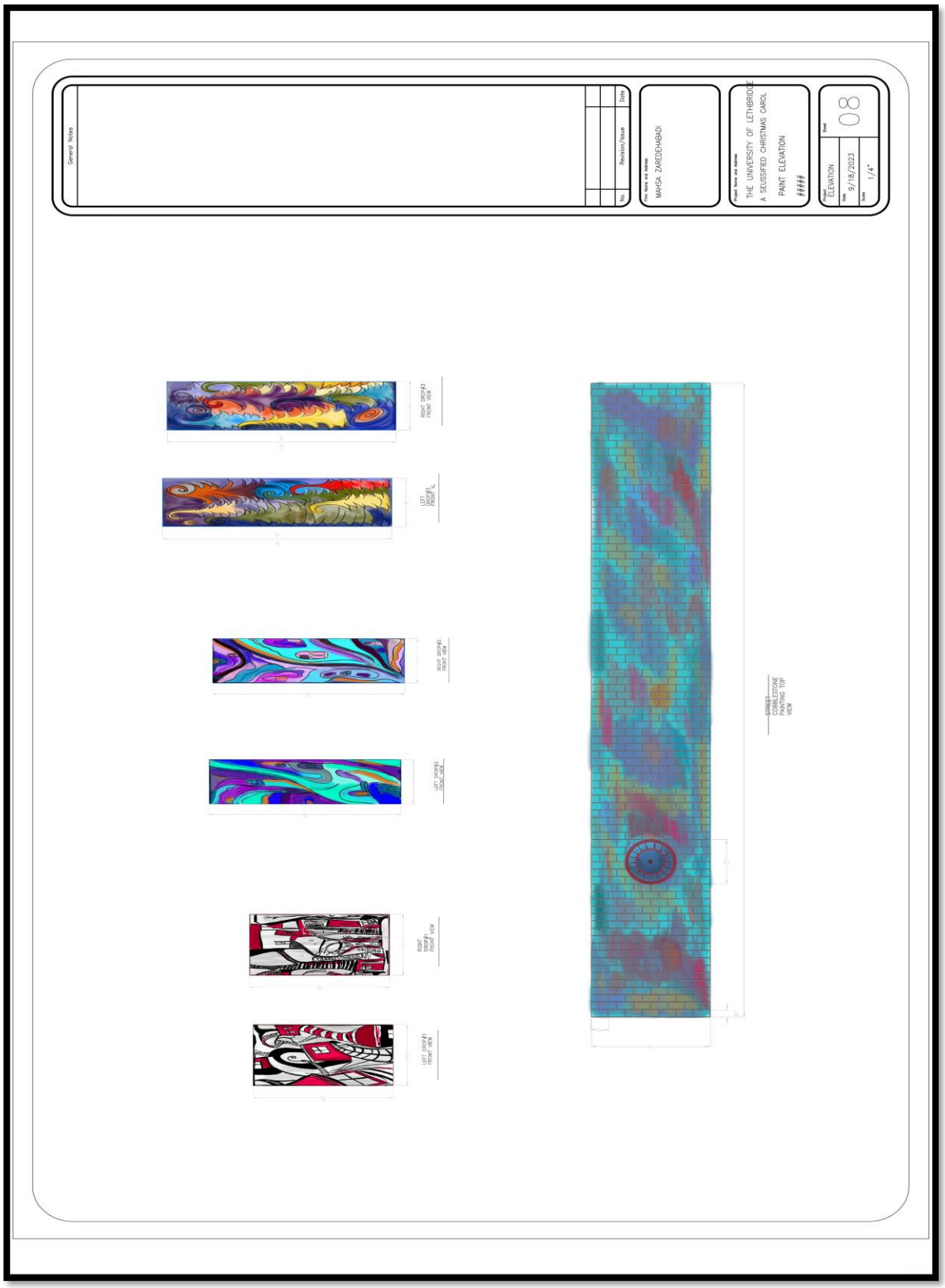


Fig. 3.8. Author's Collection. *Paint Elevation*. 2023.

Appendix E: Deepfake Technology Effects on Performers' Faces

Fig. 4.1. Author's Collection. *The Ghost of Christmas Past Deepfake Test Using DeepFaceLab Software.* 2023.

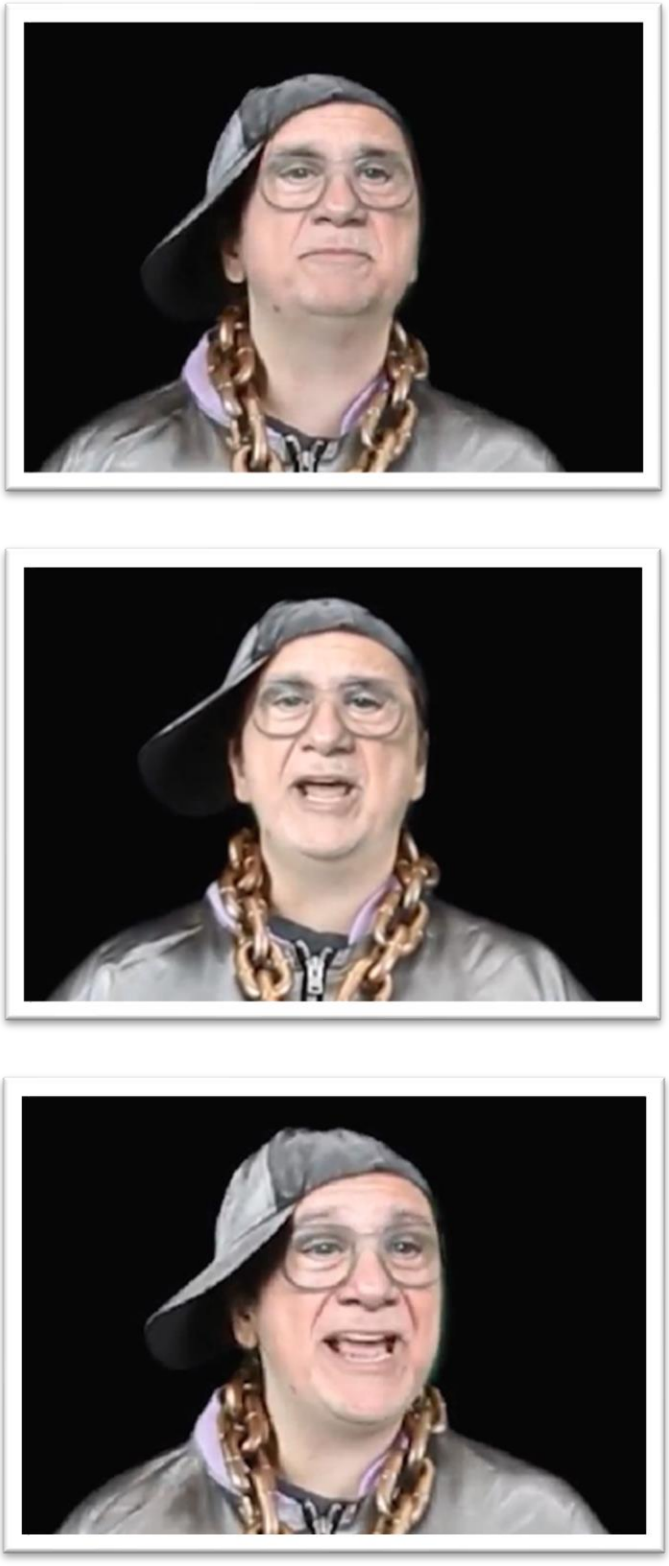


Fig. 4.2 Author's Collection. *Marly's Deepfake Test Using DeepFaceLab Software.* 2023.

Appendix F: Projection Design Sketches and Rendered Images

Fig. 5.1. Author's Collection. *Projection Design Sketches*. 2023.

Fig. 5.2. Author's Collection. *Scrooge's Room Projection Design*. 2023.

Fig. 5.3. Author's Collection. *Country Lane Projection Design*. 2023.

Fig. 5.4. Author's Collection. Sea Projection Design. 2023.

Fig. 5.5. Author's Collection. *Fred's Room Projection Design*. 2023.

Fig. 5.6. Author's Collection. *Graveyard Projection Design*. 2023.

Appendix G: Performance Images

Fig. 6.1. Author's Collection. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.2. Author's Collection. *A Seussified Christmas Carol*. Archival Photo, 2023.

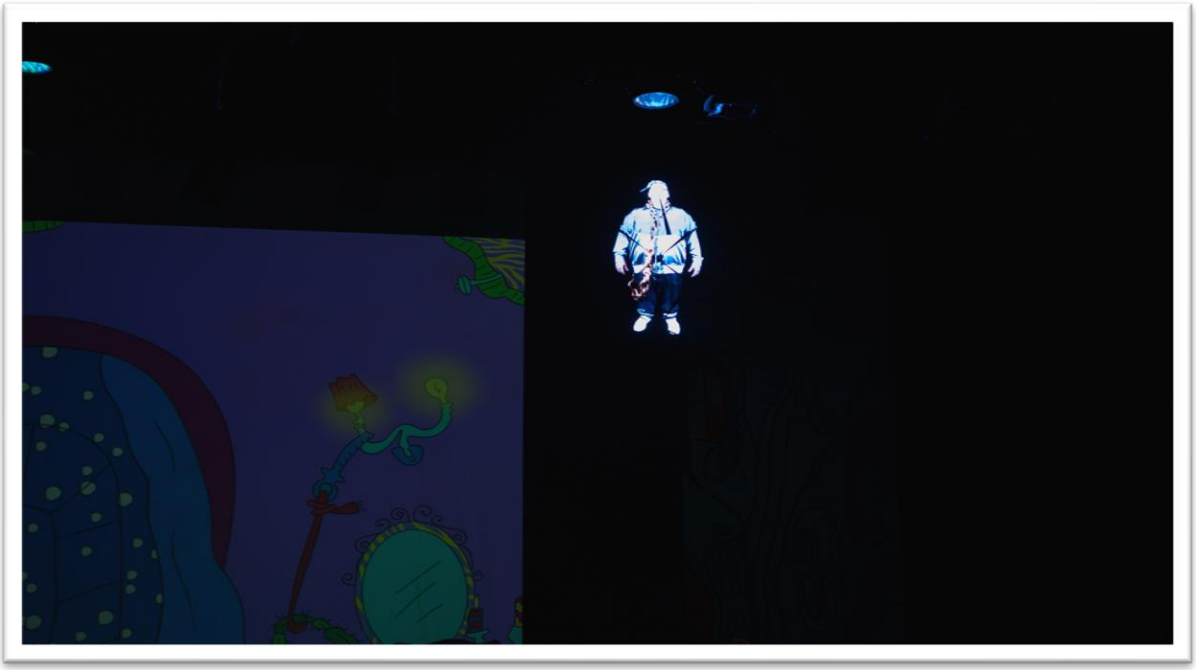


Fig. 6.3. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.4. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.5. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.6. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.7. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.8. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.9. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.10. Simon, Angeline. *Panning Scene*. Archival Photo, 2023.

Fig. 6.11. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.12. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Fig. 6.13. Simon, Angeline. *A Seussified Christmas Carol*. Archival Photo, 2023.

Appendix H: Official Poster for *A Seussified Christmas Carol*

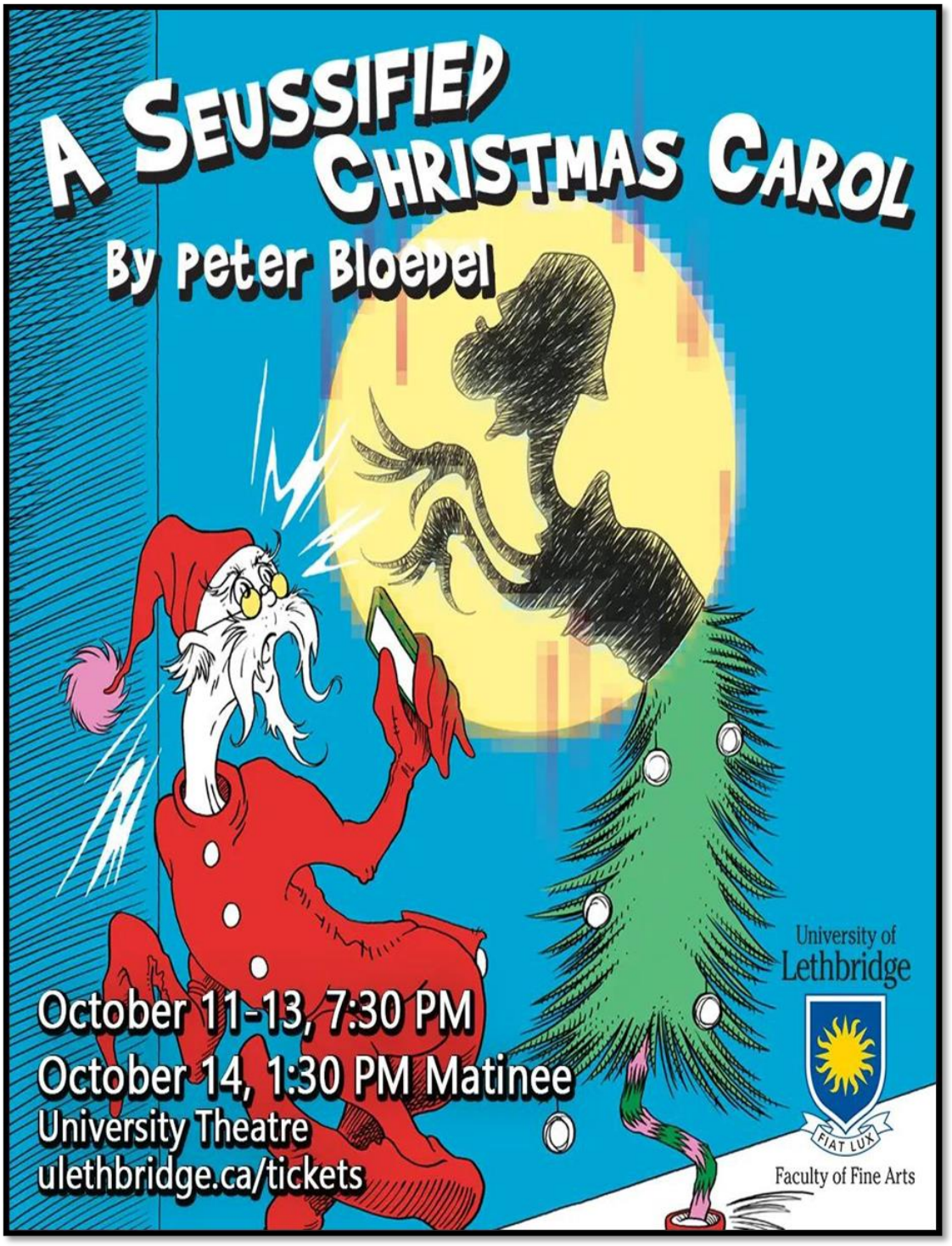


Fig. 6.14. Hillard, Sarah. *Poster for A Seussified Christmas Carol*. Archival Photo, 2023.