



Unveiling the Forgotten: 3D Reconstruction of the Colored Orphan Asylum

Xin Wen¹ and Alen Miller²

¹ University of St Andrews, St. Andrews, Scotland

² University of St Andrews, St. Andrews, Scotland
veritasx777@gmail.com

Abstract. The Colored Orphan Asylum, originating in the United States during the early to mid-nineteenth century, holds significant historical importance, not only highlighting the challenges faced by people of color in American society at that time but also serving as a stark reminder of the immense harm inflicted by racial discrimination and conflicts. However, over time, it has gradually faded from the public eye in the course of history. With the continuous advancement of technology, the utilization of digital methods for heritage preservation has become the mainstream approach in contemporary heritage conservation efforts. In this paper, we present a comprehensive exploration into the 3D reconstruction of the Colored Orphan Asylum, employing cutting-edge technology to resurrect its physical presence and cultural significance.

Through the meticulous integration of literature research, photogrammetry, and digital modeling, this study has revitalized this forgotten institution, vividly showcasing its architectural splendor and historical backdrop. By digitally reconstructing the orphanage, we aim to transcend the limitations of conventional historical interpretation, enabling scholars and the public alike to engage with its heritage in an immersive manner, thus bringing this piece of history back into the public eye.

In unveiling the forgotten, our work underscores the imperative of acknowledging and reckoning with the overlooked corners of our collective past. By harnessing the power of 3D reconstruction, we strive to foster a more inclusive and empathetic understanding of history, one that embraces the stories of all who have shaped our world.

Keywords: 3D Reconstruction, The Colored Orphan Asylum, Interactive.

1 Introduction

Preservation of cultural heritage is essential for ensuring that future generations can comprehend the past, thus playing a crucial role in the continuity of human civilization. Among these significant sites stands the Colored Orphan Asylum, a testament to the resilience and strength of marginalized communities throughout history. The Colored Orphan Asylum was established in the 1830s on Manhattan Island in New York, USA. It was the first welfare institution in the United States dedicated to housing orphaned children of color, providing shelter for African American children who had become orphans due to illness, poverty, and social injustice. However, it was destroyed during the American Civil War in 1863. [1] Starting from colonial rule and the era of slavery, the United States has grappled with racial discrimination and ethnic biases. African American children suffered particularly brutal treatment. The establishment of the Colored Orphan Asylum led to an increase in the number of orphanages that began accepting African American children. This poignant institution not only deeply influenced American welfare institution, but also served as a sanctuary for African American orphans at that time. Although this meaningful welfare institution has been destroyed, it remains worthy of study and commemoration. It serves to remind us of the profound impact of racial discrimination and war on children. This is precisely the significance of undertaking this project.

The Colored Orphan Asylum holds a unique position in American history, with its physical structure, architectural design, and material artifacts embodying the story of resilience, fortitude, and hope among African Americans. However, as its architectural core was destroyed, the narrative behind it gradually faded from public

view, leading to the gradual forgetting of this piece of history. In response to the urgent need to preserve cultural heritage, an increasing number of researchers are employing advanced techniques such as 3D reconstruction and digitization. This approach provides new opportunities for the preservation and dissemination of historical heritage, offering higher accuracy and enhanced interactivity.

This paper presents a comprehensive approach to 3D reconstruction of the Colored Orphan Asylum using advanced photogrammetric techniques and principles of digital preservation, along with web design and historical background research. By integrating methods such as image analysis, handmade sketches, model establishment and rendering, webpage development, and literature collection and analysis, the aim is to authentically recreate the spatial layout and architectural details of the orphanage and effectively disseminate its significance. The article is primarily divided into six sections: Context survey, Methodology, 3D reconstruction process, Evaluation, Future work & challenges, and Conclusion. Through interdisciplinary efforts, I hope to advance the field of digital heritage preservation and promote broader participation in diverse narratives of our shared past.

2 Context Survey

2.1 The Colored Orphan Asylum Background

New York City's Association for the Benefit of Colored Orphans, more commonly known as the Colored Orphan Asylum (COA), was the first orphanage in the United States dedicated to the care of African American children. [2]The Colored Orphan Asylum was founded by three Quakers: Anna and Hanna Shotwell and Mary Lindley Murray in Manhattan in 1836, Before its establishment, Black orphaned children were often confined in prisons or worked as beggars or laborers, as orphanages refused to take them in. [1, 3] At that time, the United States was experiencing a period of intensified racial segregation and discrimination, marked by severe social inequality. African Americans faced systemic inequalities and were often excluded from mainstream institutions. African American children, in particular, confronted significant challenges as a result of deeply ingrained racial prejudices. They frequently lacked access to proper education, healthcare, and stable homes due to these prevailing biases. Many of these children ended up orphaned or abandoned, left without adequate care or support. The first building was purchased in 1836 and was located at 12th and Fifth Avenue in Manhattan. It housed 11 children.[4]

In 1843, the orphanage relocated to a four-story house at 43 Fifth Avenue. This was also the main building for the major reconstruction of the project. In 1846, the orphanage obtained its own physician, James McCune Smith, who became the first African American doctor in U.S. history to hold a medical practice license. The newly constructed orphanage building could accommodate between 200 and 800 children. Around 1950 fewer than one-third of the children were orphans, and many children were returned to their parents around the age of 12 or placed as farm workers or household servants.[4] Until that time the Coloured Orphanage had enjoyed temporary stability and support despite its rocky operation, until the unrest broke out.

2.2 Architectural Analysis

Based on several sources, certain architectural records and documents have been located, facilitating a more accurate reconstruction within the project. The initial task at hand is to ascertain the visual attributes of the building. Within "Angels of Mercy: White Women and the History of New York's Colored Orphan Asylum," an image (see Fig. 1) has been discovered. This image depicts the first structure of the orphanage, which is the focal point of the ongoing restoration project. According to the illustration (see Fig. 1), it is apparent that the orphanage is situated amidst a relatively desolate area, with inadequate security facilities. However, despite this, the orphanage exhibits a substantial architectural scale, suggesting the capacity to accommodate a sizable number of orphans.



Fig. 1. The Fifth Avenue building at Forty-third Street.[5]

In order to achieve a more accurate reconstruction, additional photographs depicting the surroundings of the orphanage are needed. Within the 'Records of the Association for the Benefit of Colored Orphans' book, several visual records can be found (see Fig.2 & Fig.3). Despite the somewhat blurry quality of these images, given the scarcity of documentation regarding orphanages for people of color, these photographs still offer a wealth of crucial information. The orphanage features limited recreational facilities yet is surrounded by abundant greenery. Daily extracurricular activities for the students primarily involve agricultural cultivation, reflecting the rural nature of Manhattan Island during that period.



Fig. 2. Photographs of Orphanage Labor.[6]



Fig. 3. Children at play in a courtyard of the Fifth Avenue building.[6]

According to images (see Fig. 4.), it can be observed that a distant view of the sea is possible from within the orphanage. This contrasts with the present-day Fifth Avenue, where numerous towering skyscrapers in Manhattan obstruct the view of the coastline. However, such a vantage point was easily attainable in the 19th century.



Fig. 4. Interior Long-Distance View of the Building.[6]

Beyond the architectural facade, the faithful reconstruction of the interior of the orphanage holds significant scholarly importance. Drawing upon documentary accounts detailing the quotidian lives of the children, pertinent visual records capturing the internal ambience of the orphanage have been uncovered. For instance, as depicted in Figure (see Fig. 5.), it becomes apparent that the ground level of the edifice encompasses a commodious expanse suitable for organizing celebratory events during pivotal festivals. Likewise, as gleaned from Figure (Fig. 6.), the areas proximate to the windows within the edifice are indicative of zones designated for scholastic pursuits and participation in religious activities by the children.



Fig. 5. A Thanksgiving dinner of long ago.[6]

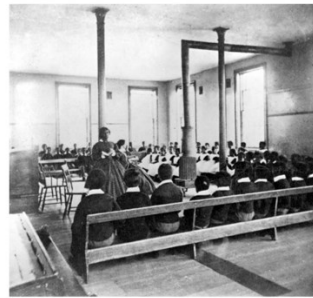


Fig. 6. Teachers imparting moral guidance for successful indentures in the Fifth Avenue building, good Friday 1861(Collection of The New-York Historical Society).[5]

3 Methodology

There are numerous methods for 3D reconstruction, but the establishment of this model aims to provide a three-dimensional reconstruction to enable a deeper understanding of this historical period. Therefore, background investigation is crucial, involving the collection and analysis of relevant historical and architectural data. Furthermore, the selection of digital technologies is pivotal in the reconstruction process. In this particular reconstruction, emphasis was placed on methods such as modeling and rendering to authentically reproduce the building as much as possible. Finally, in order to ensure accuracy and interactivity in the final presentation, an evaluation approach was adopted to gather feedback and make improvements.

The present 3D reconstruction project primarily employs two software applications, namely Blender and Unreal Engine 5 (UE5). Blender is utilized during the initial stages of modeling, where architectural models are constructed based on hand-drawn sketches and collected structural information about the building. This phase emphasizes meticulous attention to the structural intricacies of the edifice, serving as groundwork for subsequent processes. Following the completion of the modeling process in Blender, the resultant files are subsequently imported into UE5 for the purpose of texture mapping and rendering. UE5 assumes responsibility for executing

the remaining components of the project. When creating promotional web pages, using WordPress makes it convenient and efficient to build an interactive and visually appealing website.

3.1 The Colored Orphan Asylum Background

The reconstruction of the orphanage for people of color is not merely a straightforward 3D architectural reconstruction project. It involves several critical considerations. Firstly, an understanding of the architectural styles prevalent in the United States during the 19th century is essential. This includes an exploration of the housing characteristics of that era, encompassing factors such as building styles and dimensions. Additionally, meticulous examination of historical records is necessary to ascertain details concerning aspects like building height and window dimensions. Furthermore, incorporating visual evidence, particularly photographs from the relevant period, becomes integral in estimating the dimensions of the proposed reconstruction. By amalgamating the insights derived from architectural analysis, historical documentation, and visual materials, it becomes possible to approximate the length, width, and height of the intended reconstruction model with a higher degree of accuracy.

3.2 The Hand-Drawn Sketch

Subsequent to obtaining the architectural data, the creation of a hand-drawn architectural sketch becomes a pivotal step, accompanied by the incorporation of precise measurements into the drawing. This approach serves as an expedient and efficient means to attain a preliminary conceptual visualization of the main building. Given that the primary focus of the project centers on the reconstruction of the initial structure of the orphanage, the hand-drawn sketch should encompass the fundamental architectural elements and their respective dimensions. Additional embellishments and peripheral adornments can be integrated into the model during the subsequent phases of digital modeling. This method facilitates the expeditious realization of a rudimentary outline of the principal building. As the central objective pertains exclusively to the foremost edifice of the people of color orphanage, the hand-drawn sketch need only encompass the core structure of the building and its specific measurements. In the later stages of modeling, complex decorations and surrounding environments can be better integrated.

3.3 Texture Mapping

Apply textures to the model created in Blender, essentially coloring the architecture, and adding details. Here, it's important to accurately replicate the colors, materials, and patterns used in the original orphanage, aiming to closely resemble reality and make the orphanage's overall appearance as authentic as possible.

3.4 Lighting and Environment

The architectural structure. This becomes particularly critical when focusing on interior spaces. Each floor and room within the building necessitates adequate lighting; otherwise, the interior ambiance remains obscured in darkness. The precise positioning of lights is contingent upon nuanced brightness adjustments. Additionally, beyond internal illumination, the integration of natural light from the exterior is imperative.

3.5 Add Details

Within the project scope, apart from the core architectural structure, numerous supplementary elements are present. These include features such as the perimeter fencing surrounding the orphanage, the incorporation of greenery, and the inclusion of human figures. Any details that have the potential to enhance the project's overall integrity should be meticulously integrated.

3.6 Render and Text

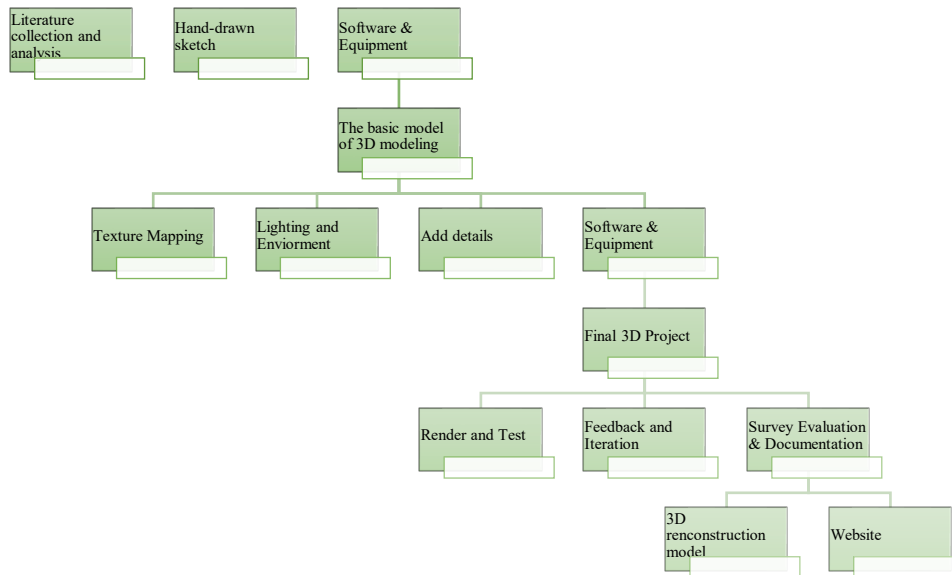
When rendering the model, it should be rendered from different directions to ensure that the details of each side of the building are complete, and it can have a good effect from different angles. Adjust as needed to improve accuracy and aesthetics. And try to perfect different lighting setups to capture the intended ambiance.

3.7 Survey Evaluation & Documentation

During the process of project refinement, progress should be constantly documented. This aids as a reference for future work. The documentation includes, but is not limited to, project processes, source references, design decisions, and any modifications related to the project. Finally, a survey should also be conducted. Based on the

survey, an assessment of the project can be carried out, identifying its strengths and weaknesses. The survey results can also help determine the direction of future work. After the project is finally completed, the project should be shared with supervisor, classmates or professors in related fields, and people who don't know the field at all. A project is a real success if it ends up being recognized not only by experts but also by people who are not in the field.

Table 1. Processes and outcomes of methodological use in projects.



4 3D Reconstruction Process

4.1 Design

In order to comprehensively recreate the architecture and the ambiance of that era, the project will be divided into two models. The first model primarily focuses on the exterior restoration of the orphanage. Within this model, the primary emphasis is placed on meticulously reconstructing the overall external appearance. Numerous architectural intricacies and contextual surroundings are incorporated to enhance the authenticity of the depiction. The second model allows for an immersive exploration of the orphanage's interior, built upon the blueprint of Manhattan Island.

4.2 Model 1

Sketch. A hand-drawn sketch based on a photograph of the building, in which the dimensions of the building are indicated. Considering that the architectural styles of 19th-century American homes were often based on Roman or Greek architecture, historically referred to as the Federal style or Greek Revival style, Federal architecture typically employed a 6-over-6 windowpane pattern. These descriptions correspond with the architectural features documented in the images of the orphanage for individuals of color.[7]

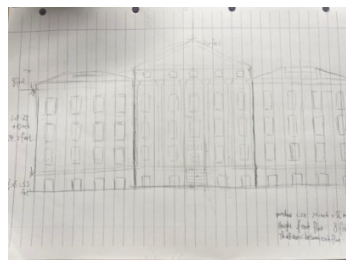


Fig. 7. Hand-drawn sketch.

Modelling. Use blender to build the model. Here the building is divided into three parts horizontally and vertically, horizontally the first part is the semi-basement of the building, the second part is the three floors of the main body of the building and the third part is the roof. Vertical is to divide the building into three parts, left, center and right. Build a small grid with windows and use a grid of 48 cubes to construct a structure measuring 4x4x3. Given that this central component is projected to extend about half a cube's height beyond the adjacent buildings, it will be constructed employing a configuration of 75 cubes arranged in a 5x5x3 layout. Similarly, utilize a stacking approach to construct the basement portion and assemble it accordingly. The roof segment takes the shape of a triangular prism.



Fig. 8. Final building.

Interaction. Incorporate details such as fences, doorplate, and greenery into the scene. Additionally, create a small separate building adjacent to the main structure to serve as a restroom. Utilize Quixel Bridge to search for and download materials from free material libraries, then import them into the project files. To avoid monotony, introduce two more buildings behind the main structure. Within the downloaded asset pack, reference character models. In the editing process, attach skeletons and animations to the characters to bring them to life. Enhance the realism and variety of the project by integrating these elements, resulting in a more immersive and engaging experience for the user.



Fig. 9. People.

Landscape. To create a more natural landscape, utilize the Landscape Editing tool to sculpt uneven terrains on the ground. Once the terrain is shaped, use brushes to add vegetation to the landscape. Next, select various plants from the asset library and integrate them into the scene. Additionally, include structures like a gazebo and a rugby frame, enhancing the overall environment. By incorporating these elements, the visual and experiential aspects of the program can be enriched to provide a comprehensive and immersive environment for users to explore.



Fig. 10. Back of building.

4.3 Model 2

Hand sketch. Creating Blender models follows steps that are broadly similar to designing the model 1. Begin by hand-drawing a rough outline of the internal layout for each floor of the building.

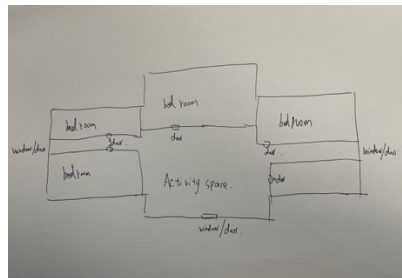


Fig. 11. Hand painted slab design.

Modelling. Utilize Blender to construct the model based on the hand-drawn sketches, employing the same methods as in the general modeling process. Once the model is complete, export it on ue5 in OBJ format.

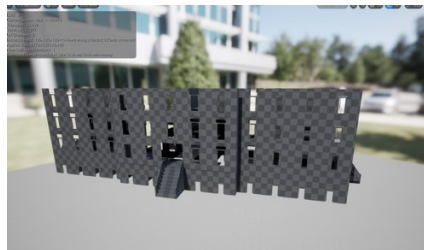


Fig. 12. Building body of model 2.

Landscape. Before uploading the Blender-created model to UE5, it's suitable to establish the landscape in UE5 first. Start by constructing a landscape of dimensions 64x64 with a resolution of 2x2. Initially, material selection can be postponed. Considering the intention to create a Manhattan-style Island, it's essential to download the "Landmass" plugin and "Water" plugins prior to commencing. After restarting the software, proceed to the landscape editing page and incorporate the Landmass tool. Adjust its size and format as required. Upload the built model in obj format to ue5. As with model 2, download the mapping package from the Quixel bridge and map the exterior of the model.

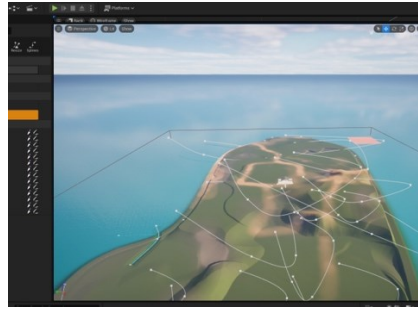


Fig. 13. Manhattan Island landscape.

Modelling in UE5. Due to potential detail loss when transferring files between Blender and UE5, a common concern arises. Specifically, when transitioning from the building's interior to its exterior, from the inside of the building to the outside of the building is transparent. To address this, create a floor for the building using a cubic structure and clip and close the edges within Blender. This will form a floorboard that you can import into UE5, ensuring a seamless transition between the building's interior and exterior.

Lighter. For the interior textures of the building, utilize resources from Quixel Bridge. Given that the decorations for each floor are generally uniform, employ a similar approach to complete the interior texturing. This entails applying the appropriate textures to each floor using a consistent method.



Fig. 14. Inside to outside (The sea can be seen).

4.4 Website

Using WordPress to create a webpage, you begin by crafting the "Home" page. Within this page, provide a concise explanation of the project at hand. Integrate buttons that allow users to interact and navigate to other pages within the website.

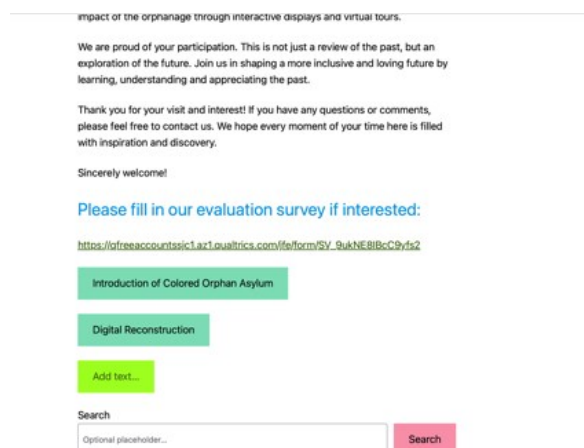


Fig. 15. Website home page.

The second page provides an overview of the Colored Orphanage, supplemented with an extensive collection of textual references, images, and videos. The 3D Reconstruction page is designed to primarily elaborate on the process of designing the current project. This section also incorporates interactive options that allow users to navigate to other sections of the website. Here, the focus is primarily on showcasing and explaining the project through screenshots and descriptions. In the process of designing the website, the primary focus is on crafting concise yet impactful introductions to the Colored Orphanage and the 3D Reconstruction project. To achieve this goal, the website predominantly employs project screenshots and relevant videos. This approach allows for an efficient and engaging presentation of both the Colored Orphanage's significance and the intricacies of the 3D reconstruction endeavor. Website link: <https://stage.openvirtualworlds.org/worldheritage2023/colored-orphan-asylum-in-new-york/>

5 Evaluation

5.1 Questionnaire

Assessing the project's completion after the 3D reconstruction is a crucial phase. The primary objective of this project is to acquaint individuals with the Colored Orphanage, aiming to provide a deeper understanding not only of the architectural aspect of the orphanage but also its historical narrative and significance beyond its physical structure. To evaluate the feasibility and public reception of the project, a survey was devised. The survey was formulated to gauge respondents' familiarity with the Colored Orphanage and their opinions regarding its reconstruction. The questionnaire primarily targeted students with diverse academic backgrounds to ensure a comprehensive range of perspectives. In total, 27 responses were received. Although the sample size is modest, the diversity in educational backgrounds enhances the credibility of the survey results. While the sample size is limited, it provides valuable insights that contribute to the project's evaluation. The original link to the questionnaire is: https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_9ukNE8IBcC9yfs2

5.2 Result Analyzes

Based on the survey results, it can be observed that the general public is highly interested in 3D reconstruction technology and wishes to understand history through this means, which underscores the significance of the project. Here, we primarily analyze two survey results that effectively assess the project.

Almost all respondents to the survey agreed to varying degrees with the use of 3D modelling for the reconstruction of the project, a question that suggests that the choice of methodology for this project was the right one.



Fig. 19. Questionnaire result 1.

The results of the survey show that users are interested in almost all aspects of the project, with the greatest interest in the history of the building, which suggests that the structure of the building should be of paramount importance in the production of the project.

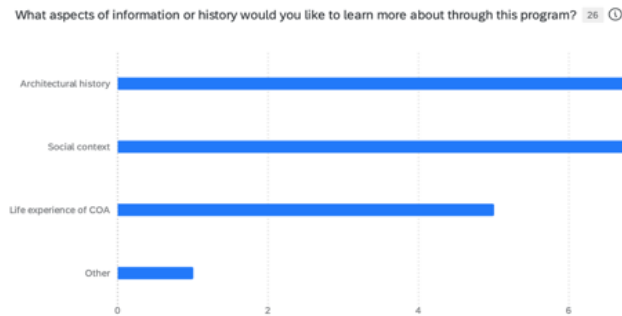


Fig. 20. Questionnaire result 2.

6 Future Work & Challenges

6.1 Future Work

Enhancing Interactive Experience. It is possible to incorporate more interactive elements into the project, such as employing artificial intelligence technology to establish a chatbot for conversational interactions. By enhancing interactivity, the project can simultaneously leverage collected data to refine its functionalities. Alternatively, integrating VR technology can enhance visual experiences, thereby augmenting the overall user engagement.

Collaboration. Collaboration with educational institutions, museums, and similar establishments presents an avenue for synergy. Furthermore, engagement with scholars specialized in American history studies and architectural academia can be cultivated to perpetuate the exploration of pertinent historical knowledge. Integration of these insights into the project's fabric not only ensures the fidelity of the reconstruction but also imbues it with pedagogical significance. By collaborating with academic experts and institutions, the project can benefit from their scholarly rigor and domain-specific insights. This collaborative approach serves to validate the accuracy of the reconstruction while also imbuing it with a deeper educational and contextual value.

6.2 Challenges

Technical Challenges. Developing intelligent and highly interactive 3D models based on AI technology requires extensive data for analysis, posing significant technical demands on developers. Training such systems also necessitates considerable time. Additionally, implementing VR interactions similarly demands developers to possess relevant knowledge and expertise in the field.

Sustainability. Ensuring the enduring stability of the project and the consistent execution of updates and maintenance present substantial hurdles, especially following the potential integration of gamification into the project.

7 Conclusion

This research endeavor is dedicated to exploring the colored orphan asylum in New York, USA. In order to comprehensively delve into these institutions, a multi-dimensional approach was employed, combining historical research, architectural plans, 3D modeling, and web design. This successful fusion of techniques has resulted in the creation of an interactive virtual space. The completion of the 3D reconstruction project resurrects this once-destroyed building in electronic form, presenting an opportunity for those interested in the historical significance of this institution to traverse time and understand its profound role in the past. The realization of this project harnessed the power of interdisciplinary collaboration, showcasing how historical research, architectural expertise, and advanced technology converge to illuminate the past in a captivating and meaningful manner. The project underscores the importance of bridging the gap between the past and present, inviting individuals from all walks of life to reflect upon the lessons of history and consider their relevance today. In a world where racial inequality and discrimination persist, this project stands as a symbol of education and empathy. By immersing users in the reconstructed orphanage environment, our aim extends beyond merely conveying historical facts; it is to cultivate a deeper understanding of the intricate social issues that shaped the history of this institution. The

past is not just a collection of distant events; it serves as a mirror reflecting society's struggles and progress, prompting us to contemplate the direction of our future.

By analyzing a large amount of documentation, it was possible to recreate the details of the building as accurately as possible in a 3D reconstruction, which can be used to move to different areas while using the project. The two different models bring two different immersive experiences, through which one can not only understand the exterior and surroundings of the building but also explore the interior of the building, adding an interactive element that allows the user to gain a deeper understanding of the history of the building, and finally disseminating it to a wider and more diverse group of people in the form of a website that is easily accessible to all.

In conclusion, the 3D reconstruction project of colored orphan asylum presents a historiographical approach endowed with profound insights and educational significance. By surmounting challenges pertaining to technology and time constraints, it has facilitated the integration of this historical period into the contemporary milieu, thereby fostering contemplation on matters of social diversity and inclusivity. It is imperative to recognize that this project transcends the mere reconstruction of history; it serves as a beacon of enlightenment for the present societal landscape.

Acknowledgements

I am profoundly grateful for the support and guidance I have received throughout the journey of completing this dissertation. This work would not have been possible without the unwavering assistance, encouragement, and contributions of many individuals.

First and foremost, I express my profound gratitude to my supervisor, Alan Miller. Throughout the entirety of the research endeavor, your steadfast guidance, encouragement, and technical support have been invaluable. Your insightful feedback and unwavering dedication have played a pivotal role in shaping the trajectory of this study. Under your mentorship, I have made significant strides in my academic progress.

Grateful for the invaluable research opportunities provided by the **University** of St Andrews, which have been instrumental in shaping my academic trajectory. Sincere thanks to the professors who offered their assistance during this period. I also extend my heartfelt appreciation to my family for their unwavering support and assistance.

Finally, many thanks to the participants who were willing to contribute their time and insights to this study. Their participation has provided important input into the revision and future work of the study.

References

1. Reef, C., *Alone in the World Orphans and Orphanages in America*. 1st ed. Clarion Books, New York (2005).
2. Convention. *Public Choice*, 136, 293–313. <https://doi.org/10.1007/s11127-008-9297-7> Enhanced Reader. (n.d.).
3. Fox, G., *George Fox's Journal*. 1st ed. Isbister's Standard Abridgments, London (1903).
4. The Colored Orphans Asylum of New York (1836-1946), <https://www.blackpast.org/african-american-history/colored-orphans-asylum-new-york-1836-1946/>, last accessed 2023/06/16.
5. Seraile, W., *Angels of Mercy: White Women and the History of New York's Colored Orphan Asylum*. 1st ed. Fordham University Press, New York (2013).
6. Records of the Association for the Benefit of Colored Orphans, 1836-1972 (bulk 1850-1936), <https://cdm16694.contentdm.oclc.org/digital/collection/p15052coll5/id/40528>, last accessed 2023/08/12.
7. Indiana Landmarks, <https://www.indianalandmarks.org/historic-houses/19th-century-high-style/>, last accessed 2023/08/14.