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Creation of the virtual exhibition "Scandinavian Mythology in Digital Space".

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Supervisor: Andre Sääsk

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TARTU ÜLIKOOL
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Ilja Kalošin

Virtuaalse näituse „Skandinaavia mütoloogia digitaalses ruumis“ loomine.

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KEYWORDS

Unreal Engine 5 (UE5) - A cutting-edge game engine developed by Epic Games, used for creating immersive 3D environments and experiences.

Midjourney - An AI tool used for generating digital art from text descriptions.

Meshy AI - An AI platform that can generate 3D models based on textual descriptions provided by the user.

.obj Format - A standard file format that stores three-dimensional object data, commonly used for sharing models between 3D graphics programs.

Blueprints - A visual scripting system in Unreal Engine 5 that allows developers to create game logic and gameplay without traditional text-based programming.

Lumen - A global illumination system within Unreal Engine 5 that creates realistic lighting in 3D environments.

Post Process Volume - A feature in Unreal Engine that allows developers to apply various visual effects to a scene, like color correction or blur, to enhance the overall look.

Quixel Bridge - A software that provides access to a vast library of 3D assets, which can be used in Unreal Engine 5.

Drag and Drop - A simple method to import assets into Unreal Engine 5 by selecting files from the desktop and moving them into the engine's interface.

PNG - A type of image file format that supports lossless data compression and transparency, making it suitable for digital art.

Viking Drakkars - Norse longships that were used during the Viking Age for exploration, trade, and warfare.

Eddas - Ancient Norse manuscripts that contain mythological and heroic poems and stories, crucial sources for understanding Norse mythology.

Yggdrasil - The mythical World Tree in Norse cosmology that connects the Nine Realms.

Ragnarok - In Norse mythology, the prophesied cataclysmic event that would lead to the death of many gods and the rebirth of the world.

INTRODUCTION

In the realm of cultural heritage and education, the ancient narratives of Scandinavian mythology hold a unique place, encapsulating the beliefs, values, and imagination of the Norse peoples. However, despite their rich narrative depth and cultural significance, these stories face the challenge of remaining relevant and engaging to a modern audience increasingly distanced from traditional modes of learning and interaction. This thesis proposes the creation of a virtual exhibition titled "Scandinavian Mythology in Digital Space" to bridge this gap, leveraging cutting-edge technology to reinvigorate interest and accessibility in Norse mythology.

The primary goal of this thesis is to design, develop, and assess the impact of a virtual exhibition that utilizes the Unreal Engine 5 platform, along with advancements in artificial intelligence, to create an immersive, interactive, and educational experience focused on Scandinavian mythology. This project aims not only to preserve and present ancient Norse myths but also to innovate how we engage with cultural heritage in the digital era.

To achieve this goal, the following tasks will be undertaken:

1) Conduct comprehensive research on Scandinavian mythology to curate informative and engaging content for the virtual exhibition.

2) Analyze existing digital exhibition tools and technologies to identify gaps and opportunities for innovation in the presentation of cultural heritage.

3) Develop the virtual exhibition using Unreal Engine 5, capitalizing on its advanced features to create a visually stunning and interactive environment.

4) Integrate AI-generated models and artefacts into the exhibition to enhance realism and immersion, ensuring a captivating user experience.

5) Evaluate the effectiveness of the virtual exhibition in engaging users with Scandinavian mythology, using feedback and analytics to measure impact and identify areas for improvement.

Integral to this endeavor will be examining critical literary sources on Scandinavian mythology and digital exhibition methodologies. Works such as "The Poetic Edda" and "The Prose Edda" by Snorri Sturluson will provide foundational mythological content. At the same time, "Digital Heritage and Culture: Strategy and Implementation" by Vito Cappellini will offer insights into the digitization of cultural heritage. Additionally, "The Unreal Engine Developer's Cookbook: Designing Digital Worlds with Unreal Engine 4" by Tim Elek and Zak Parrish will be a crucial resource for understanding the technical aspects of using Unreal Engine in cultural heritage projects.

This thesis will unfold in the future, exploring uncharted territories in digitizing cultural heritage through an innovative blend of storytelling, technology, and interaction design. By transcending traditional boundaries and creating a space where ancient myths come alive digitally, this project aspires to set a new benchmark for how we connect with and preserve our shared cultural legacies.

RESEARCH GOALS

The digital age offers unparalleled opportunities for cultural heritage preservation and education. However, it poses significant challenges and questions, particularly when engaging modern audiences with ancient cultural narratives like Scandinavian mythology.

1. Engaging a Diverse, Modern Audience with Ancient Mythology:

Traditional methods of cultural education need help to captivate the digital-native generation. How can the rich, complex narratives of Scandinavian mythology be presented in a manner accessible and engaging to a global audience with varying levels of prior knowledge?

2. Authentic Representation of Cultural Heritage in Digital Formats:

Digitizing cultural heritage raises questions about authenticity and the preservation of cultural nuances. How can the virtual exhibition ensure an authentic representation of Scandinavian mythology, avoiding oversimplification or cultural misinterpretation?

3. Leveraging Technology for Immersive Educational Experiences:

While digital platforms offer new educational avenues, not all technologies are equally effective in creating immersive educational experiences. What makes Unreal Engine 5 a suitable platform for this purpose, and how can AI-enhanced models contribute to a more immersive learning environment?

4. Accessibility and Sustainability of Digital Cultural Exhibitions:

Digital projects require ongoing maintenance and updates to remain accessible and relevant. What strategies can be employed to ensure the long-term sustainability and accessibility of the virtual exhibition?

5. Measuring the Impact of Virtual Exhibitions on Cultural Education:

The effectiveness of virtual exhibitions as educational tools needs to be better understood. How can the impact of the virtual exhibition on user engagement and learning about Scandinavian mythology be quantitatively and qualitatively measured?

1. INTRODUCTION TO SCANDINAVIAN MYTHOLOGY

1.1. Historical Context and Origins

The study of Scandinavian mythology offers a window into the spiritual and societal framework of the Norse people, stretching back to the Viking Age and earlier. This mythology is not a monolithic belief system, but a complex tapestry woven from the varied threads of oral traditions and later literary sources, primarily the Poetic Edda and the Prose Edda, compiled in Iceland during the 13th century. These collections of poems and tales are pivotal to our understanding of Norse mythology, featuring gods, giants, and heroes whose stories were integral to the cultural fabric of the Norse world.

The Viking Age, roughly spanning the late 8th to the early 11th century, marks a significant period in the proliferation of these myths. The Vikings, known for their raids, trade, and exploration, carried their beliefs across Europe and beyond, influencing and being influenced by the cultures they contacted. A polytheistic belief system characterized this period. Deities such as Odin, Thor, and Freyja were venerated in a pantheon representing various aspects of life and the cosmos, including war, thunder, love, and fertility.

The origins of Scandinavian mythology, however, stretch further into the past, rooted in the pre-Christian religious practices of the Germanic peoples. This broader context reveals a common mythological framework shared among the Germanic tribes, with variations that evolved over time and through interactions with neighbouring cultures, including the Celts, Slavs, and Roman Empire. The transition from oral to written traditions marks a pivotal moment in preserving Norse mythology, as it encountered and merged with Christian influences, transforming in the process.

Understanding the historical context and origins of Scandinavian mythology necessitates an exploration of archaeological findings, such as runestones, burial mounds, and other material culture, which provide physical evidence of the myths and religious practices of the Norse people. These artefacts, coupled with literary sources, offer insights into the evolution of Norse mythology, reflecting a dynamic interplay between myth, culture, and history.

This exploration into the historical context and origins of Scandinavian mythology not only illuminates the beliefs and values of the Norse people but also underscores the complexity and adaptability of their mythological tradition. It reveals a cultural legacy that continues to captivate and inspire through its transformation and enduring appeal.

1.2. Key Myths and Their Significance

In exploring the theoretical underpinnings of Norse mythology, one must delve into the significance of its key myths, which serve not only as stories of gods, giants, and heroes but as foundational elements reflecting and shaping the culture, beliefs, and societal norms of the Norse people (Davidson, 1993). This section examines the core narratives of Scandinavian mythology, their thematic relevance, and their enduring impact on cultural identity and collective memory.

1.2.1. Creation and Cosmology

The Norse creation myth, as detailed in sources like the *Poetic Edda* and Snorri Sturluson's *Prose Edda*, presents a universe born from the void (Ginnungagap), where the worlds emerge from the interplay between elemental forces of fire (Muspelheim) and ice (Niflheim) (Sturluson, 2005). This narrative underscores a central theme in Norse thought: the cyclical nature of existence, where destruction and creation are intimately connected, reflecting an understanding of the natural world's volatility (Lindow, 2002).

1.2.2. The Pantheon: Gods and Their Domains

Its pantheon of gods and goddesses is central to Norse mythology, each with distinct roles and attributes. Odin, Thor, and Freyja represent multifaceted aspects of life and the environment, serving as allegories for natural phenomena, human virtues, and existential questions (Abram, 2011).

1.2.3. Heroes and Human Endeavors

The sagas and tales of heroes like Sigurd and the *Völsung Saga* encapsulate the Norse ethos of heroism, honour, and fate (Byock, 1990). These stories underscore the importance of legacy and the belief in an immutable destiny, reflecting values paramount in Viking age societies.

1.2.4. Ragnarök: The Eschatological Myth

Ragnarök, the prophesied apocalypse, encapsulates the cyclical concept of time and existence in Norse mythology, embodying resilience and perpetual renewal in the face of inevitable change (Davidson, 1993).

1.2.5. Theoretical Reflections

The theoretical examination of Norse myths transcends a mere recounting of ancient narratives, positioning these stories as pivotal elements in the broader tapestry of human culture and societal development. Norse mythology, with its rich pantheon of gods, heroes, and complex cosmological beliefs, provides a lens through which to explore themes of power, conflict, and the human condition. These stories reflect not only the worldviews and values of the Norse people but also offer contemporary scholars a rich field for exploring the intersections of mythology, psychology, and sociology.

Jungian analysis, for instance, finds in Norse mythology a vibrant source for understanding archetypal figures within the collective unconscious, suggesting that figures like Odin and Thor embody universal patterns of human psychology (Jung, 1959). This perspective underscores the enduring relevance of these myths, arguing that they resonate with deep psychological structures and continue to influence modern consciousness.

Furthermore, the cyclical nature of Norse mythology, especially as manifested in the narrative of Ragnarök, provides a fertile ground for exploring themes of destruction and renewal, reflecting broader philosophical inquiries into the nature of time and the universe. This eschatological vision resonates with contemporary ecological and existential concerns, suggesting a worldview in which end and beginning are intertwined, offering insights into contemporary discussions about sustainability and resilience (Williams, 2016).

Applying structuralist approaches to Norse mythology has also revealed the underlying binary oppositions within these narratives, such as order/chaos, creation/destruction, and gods/giants, providing insights into the fundamental structures of human thought and culture (Levi-Strauss, 1963). This analysis highlights the mythological framework as a mirror reflecting the fundamental conflicts and dualities inherent in the human experience.

In integrating these theoretical perspectives, Norse mythology emerges as a dynamic field of study that bridges the ancient and the modern, inviting ongoing exploration and interpretation. Its stories and symbols continue to inspire and challenge, providing a deep well of material for scholarly inquiry into the nature of myths and their role in human culture.

2. THE CONCEPT OF A VIRTUAL MUSEUM

2.1. Evolution of Museum Concepts: From Physical to Virtual

The evolution from physical to virtual museums reflects the broader transformation within cultural preservation and knowledge dissemination spurred by advancements in digital technology. Museums have historically served as guardians of cultural, historical, and scientific heritage, providing spaces for public engagement with artefacts of human civilization (Falk & Dierking, 2013). Critical in conserving heritage and facilitating cultural exchange, these institutions grapple with limitations such as geographical reach and artefact preservation challenges. The onset of digital technologies in museum practices began to mitigate these constraints, initially through digital archives and virtual tours, thus extending museums' reach and enhancing collection accessibility (Parry, 2010).

The 21st century heralded the emergence of the virtual museum, employing 3D modelling, virtual reality (VR), and augmented reality (AR) to craft immersive and interactive experiences. This shift not only widened museums' audiences by overcoming physical boundaries but also redefined visitor experiences, making them more engaging (Kotler et al., 2008). Virtual museums represent a new cultural engagement paradigm, allowing global users to explore artefacts and narratives in a participatory manner, thereby dismantling traditional access and learning barriers.

This transition holds profound implications for cultural education and accessibility. Virtual museums democratize heritage access, enabling individuals worldwide to explore collections and exhibits remotely (Din & Hecht, 2007). Additionally, the interactivity inherent in virtual museums aligns with modern educational trends toward experiential learning, offering users personalized engagement with cultural content. Despite these advancements, challenges such as the digital divide and the authenticity of digital interactions remain significant (Din & Hecht, 2007).

In conclusion, the evolution towards virtual museums encapsulates the challenges and opportunities of digital transformation in cultural preservation. As technology advances, the museum concept evolves, offering new methods for exploring, understanding, and preserving cultural heritage. This transition marks a new museology era, where digital innovation facilitates greater access, engagement, and understanding of our collective heritage, bridging past and future cultural exploration and education.

2.2. Advantages of Virtual Museums in Cultural Preservation

Expanding on the advantages of virtual museums in cultural preservation with detailed insights from the referenced sources enhances the academic rigor of the discussion. Here's a more in-depth look into the contributions of these sources to the topic.

2.2.1. Global Accessibility

Din and Hecht's "*The Digital Museum: A Think Guide*" (2007) is a comprehensive exploration of the transition museums are making from physical to digital spaces. The authors emphasize the role of digital technology in democratizing access to cultural heritage. They argue that virtual museums break down geographical and socio-economic barriers, enabling people from diverse backgrounds and locations to explore cultural artifacts and exhibitions they might not have had the chance to experience otherwise. This work highlights the potential of virtual museums to foster a more inclusive understanding of global cultures.

2.2.2. Preservation of Fragile Artifacts

In "*Museums in a Digital Age*" (2010), Parry delves into the technological advancements that have revolutionized the preservation and presentation of cultural heritage. The book outlines various digital preservation techniques, including 3D scanning and high-resolution photography, which allow for the meticulous replication of artifacts. This not only aids in the preservation of delicate items by minimizing physical handling but also facilitates detailed online exhibitions that offer visitors an up-close view of artifacts that would typically be secured behind glass or not displayed at all due to their fragile nature.

2.2.3. Interactive and Engaging Learning Experiences

Kotler, Kotler, and Kotler's work, "*Museum Marketing and Strategy: Designing Missions, Building Audiences, Generating Revenue and Resources*" (2008), explores the transformative potential of digital technologies in creating engaging and educational museum experiences. The authors discuss how interactive exhibits, augmented by technologies like VR and AR, can transform visitor engagement from passive observation to active participation. They provide case studies of museums that have successfully integrated these technologies to enhance storytelling and immersive learning, thereby deepening visitors' connection to cultural narratives and histories.

2.2.4. Cost-Effectiveness and Scalability

Din and Hecht, in their guide, also address the logistical and financial benefits of virtual museums. They note that while the initial development of digital exhibitions requires investment in technology and expertise, the long-term costs are significantly lower than those associated with physical exhibitions. The scalability of virtual museums allows for continuous expansion and updating of exhibits without the need for additional physical space or resources, making it an efficient model for the dynamic presentation of cultural heritage.

2.2.5. Conclusion: The Digital Preservation of Culture

Concluding the examination of virtual museums it is evident that these platforms significantly enhance the accessibility, preservation, and interaction with cultural heritage. Referencing Din and Hecht (2007), democratizing access through virtual museums addresses historical barriers, broadening the audience base. The importance of digital technologies in preserving fragile artefacts, as outlined by Parry (2010), showcases how virtual spaces can safeguard heritage while making it widely accessible. Furthermore, the interactive learning experiences emphasized by Kotler, Kotler, and Kotler (2008) highlight the pedagogical potential of these platforms in engaging audiences with cultural narratives in a profound manner.

Moreover, the scalability and cost-effectiveness discussed by Din and Hecht (2007) present virtual museums as a sustainable approach to cultural presentation, capable of evolving alongside technological advancements. Thus, virtual museums emerge as vital in the contemporary landscape of cultural preservation, offering innovative solutions to traditional challenges faced by physical museums.

3. TECHNOLOGICAL FOUNDATION FOR THE MUSEUM

3.1. Unreal Engine 5: A Platform Overview

Unreal Engine 5 (UE5), developed by Epic Games, represents the forefront of game engine technology, offering creators across industries a powerful platform for building interactive 3D content. Its impact stretches beyond video game development, touching sectors such as film production, architectural visualization, automotive design, and educational content. The introduction of UE5 has been a game-changer, setting new standards for visual fidelity, real-time rendering, and user accessibility. UE5's significance lies in its revolutionary approach to content creation, highlighted by features such as Nanite Virtualized Geometry and Lumen Global Illumination. These features, along with seamless Quixel-Megascans integration and the innovative MetaSounds audio system, facilitate the creation of cinematic-quality visuals and immersive audio environments. Moreover, UE5's World Partition and Data Layers system streamlines the development of vast, detailed virtual worlds, making it an ideal tool for projects requiring high levels of detail and complexity.

The versatility of UE5 extends to various applications. In game development, indie developers and large studios can bring their visions to life with unprecedented detail and interactivity. The film and television industry benefits from UE5's real-time rendering capabilities, instrumental in virtual production and visual effects. Architects and designers utilize the engine for visualizations, creating lifelike, interactive models that enhance client presentations and project planning. Furthermore, UE5's support for VR and AR technologies opens up new possibilities for immersive experiences in education, training, and entertainment.

Choosing UE5 to create a virtual museum capitalizes on these strengths. The engine's advanced rendering capabilities ensure that every artefact and environment within the museum is presented with striking realism. At the same time, its support for interactivity allows visitors to engage with the exhibits in meaningful ways. The scalability of UE5 also ensures that the virtual museum is accessible to a broad audience, regardless of the platform. The decision to leverage UE5 for this project was driven by the desire to create a virtual space that combines educational value with a visually captivating experience. By employing UE5's cutting-edge features, the "Scandinavian Mythology in Digital Space" museum transcends traditional boundaries, offering users an immersive journey through the rich tapestry of Norse mythology and Viking heritage.

3.1.1. Volumetric Fog

Volumetric Fog plays a pivotal role in adding depth and atmosphere to the virtual spaces, creating a sense of mystique and authenticity that resonates with the thematic essence of Norse mythology. By simulating the scattering of light as it interacts with microscopic particles in the air, volumetric fog enhances the realism of the environment, making the virtual forest trail more engaging and lifelike. This feature not only contributes to the aesthetic appeal but also aids in storytelling, evoking a sense of time and place that is integral to the mythological narrative.

***Figure 1**. Volumetric fog effect creating an ethereal atmosphere in UE5's virtual environment.*

3.1.2. Quixel Bridge Integration

Quixel Bridge integration stands out as a game-changer, providing access to a vast repository of high-quality photogrammetry assets. These assets have been judiciously utilized to populate the virtual museum with textures and elements that boast unparalleled realism. From the intricate carvings on Viking artifacts to the rugged textures of the Nordic landscape, Quixel Bridge assets have allowed for a detailed and authentic representation of the Viking Age, enriching the visitor's exploration with visual fidelity.

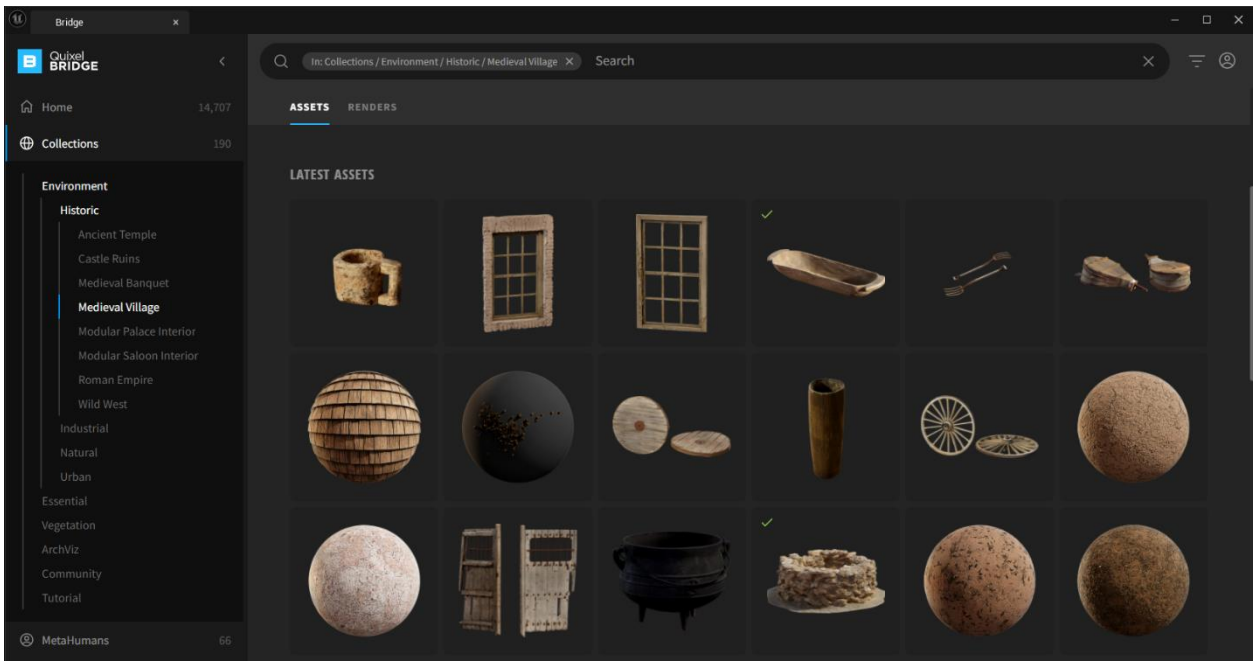

Figure 2. *Quixel Bridge interface showcasing a selection of medieval village assets.*

3.1.3. Advanced Lighting Techniques

The exhibition further benefits from Advanced Lighting Techniques available in UE5, notably including the dynamic global illumination offered by Lumen. This lighting system adapts in real-time to changes in the virtual environment, ensuring that every artifact and exhibit is presented in the best possible light. The nuanced shadows and reflections contribute to a sense of depth and realism, enhancing the visual quality of the museum and making each artifact come alive.

Figure 3. *Dynamic lighting and shadow play along the virtual museum pathway, crafted in UE 5.*

3.1.4. Additional Engine Features

In addition to these features, the project leverages other UE5 capabilities like the World Partition system for seamless level streaming and Temporal Super Resolution for maintaining high visual quality without compromising performance. These technical advancements enable the creation of expansive, detailed virtual environments that are both engaging and accessible to a wide audience.

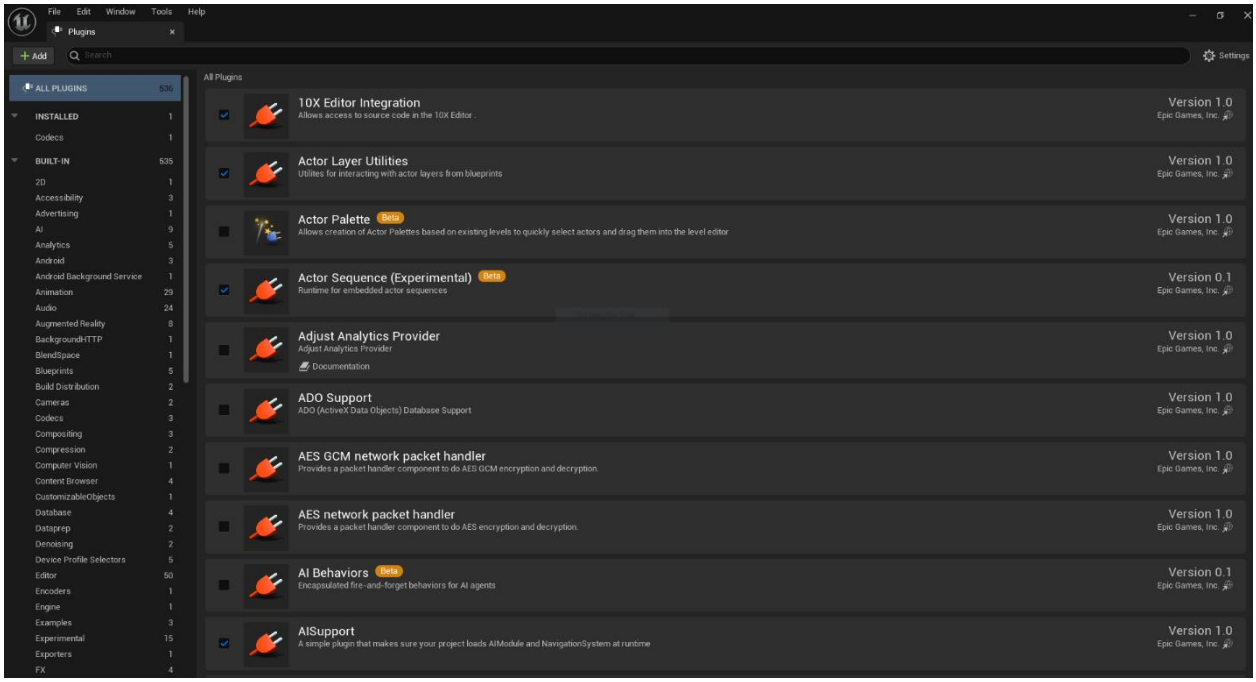

Figure 4. *A glimpse of Unreal Engine 5's plugin management system, illustrating the extensive customization options available for virtual environment development*

3.2. Unreal Engine 5: Challenges in Development and Solutions

While Unreal Engine 5 presents numerous advantages for creating virtual museums, developers may encounter various challenges. Addressing these challenges is essential for harnessing the full potential of UE5 in the context of cultural heritage.

Performance Optimization: High-fidelity graphics and complex simulations in UE5 can be demanding on hardware, potentially limiting performance and accessibility. Solutions include employing level-of-detail (LOD) techniques, optimizing asset polycounts, and using efficient lighting to balance visual quality with performance. Additionally, Unreal Engine's profiling tools can identify and resolve performance bottlenecks.

Learning Curve: UE5's advanced features come with a steep learning curve, especially for those without experience in game development or 3D modelling. To mitigate this, developers can use Unreal Engine's comprehensive documentation, tutorials, and community forums. Educational institutions and cultural organizations can also offer training workshops to equip their teams with the necessary skills.

Asset Management: The sheer volume of high-quality assets available through Quixel Bridge can overwhelm developers, leading to difficulty in managing and organizing these resources. Clear asset management protocols can be established to address this, and UE5's built-in tools can be used to categorize and streamline the workflow.

Historical Accuracy: Maintaining historical accuracy is paramount when recreating artifacts and environments. This involves extensive research and consultation with historians and cultural experts. There's a need to study historical sources diligently to ensure every element within the virtual museum is a true reflection of the era it represents.

Interactivity and Narrative Design: Crafting interactive elements and narratives that are both engaging and educational requires careful planning. This challenge can be addressed by adopting a user-centred design approach, where feedback from potential visitors is incorporated throughout the development process. Iterative design and usability testing are crucial in refining the visitor experience.

Technical Constraints: Some of UE5's most innovative features are still in development or labelled as experimental, posing risks for long-term project stability. Developers can overcome this by maintaining flexibility in their design choices and being prepared to adapt to new engine updates or alternative solutions.

Sustainability and Future-Proofing: Ensuring the long-term viability of a virtual museum project can be challenging. Regular updates and maintenance are necessary to keep the software compatible with new hardware and operating systems. Developers can facilitate more accessible updates and content additions over time by building a modular and scalable project structure.

In conclusion, while UE5 offers a groundbreaking platform for cultural heritage projects, it also presents specific challenges that require strategic planning and problem-solving. By acknowledging these hurdles and implementing thoughtful solutions, developers can fully leverage UE5's capabilities to create virtual museums that are not only technologically advanced but also stable, accessible, and historically accurate.

4. INTEGRATION OF AI IN MUSEUM EXHIBIT CREATION

4.1. Midjourney: Generating Artistic Visuals for Norse Mythology

Midjourney is an artificial intelligence program specializing in creating images from textual descriptions. It leverages a type of neural network known as a generative adversarial network (GAN), which is particularly adept at generating high-resolution and realistic images. This AI technology works by training two neural networks simultaneously: create images (the generator) and evaluate them (the discriminator). Through this process of creation and critique, the system learns to produce artwork that closely aligns with human aesthetics and thematic intentions.

For the "Scandinavian Mythology in Digital Space" project, Midjourney is invaluable in transforming written historical and mythological descriptions into vivid visual representations. For instance, by inputting detailed descriptions of Thor's hammer, Mjölnir, the AI can generate a variety of artistic interpretations that can then be reviewed and refined. These generated images complement the textual information within the virtual museum, enhancing the visitor's experience by providing an immediate visual reference for the mythological concepts discussed.

The neural network is not just a tool for replication but an artistic medium in itself. It interprets the nuances of the provided text, such as "a foggy morning in a Viking village" or "the intricate carvings on a Norse longship." It produces images that capture these scenes' essence with a depth beyond literal illustration. The AI can capture mood, texture, and emotion, translating these abstract qualities into stunning visual art.

The use of Midjourney in this project allows for a creative exploration of Norse mythology, giving form to the legendary creatures and deities that inhabit these stories. For instance, a description like "the fearsome wolf Fenrir breaking free from his chains" prompts Midjourney to generate various images, from the dramatic to the surreal, each with its interpretation of the myth.

Examples in generating visuals for the virtual exhibition, one can use Midjourney to create:

- **Ethereal landscapes that represent the Nine Worlds of Norse cosmology.**

Figure 5. *AI-generated artistic interpretations of the Nine Worlds in Norse mythology, showcasing the diverse landscapes from the ethereal mists of Niflheim to the verdant valleys of Vanaheim.*

- **Portraits of gods and goddesses that reflect their attributes and stories.**

Figure 6. *AI portraits of Scandinavian gods and goddesses, capturing the essence of their mythological narratives and attributes.*

- **Scenes depicting critical events from Norse sagas, like the building of Asgard's wall.**

Figure 7. *AI interpretations of pivotal Norse saga scenes, including the construction of Asgard's fortifications.*

The AI's advanced algorithms offer a remarkable ability to capture and convey the aesthetic and emotional essence of Norse mythology. The project uses iterative design to tap into the neural network's strengths, generating images that provide compelling and thematically consistent visuals. This method allows for a vast exploration of creative possibilities, presenting mythological narratives in innovative and visually engaging ways.

Midjourney stands out as a particularly adept solution for this project due to its capacity for high-quality image generation that can adapt to various artistic styles. Whether rendering the ethereal beauty of the Nordic landscapes or the intricate details of Viking craftsmanship, the AI facilitates a visual storytelling experience that resonates with the mystique of the legends it represents.

By fusing Midjourney's artistic visuals with Unreal Engine 5's immersive capabilities, the virtual museum experience becomes a learning opportunity and a journey through time and imagination. The integration of this neural network is a testament to the potential of AI in cultural preservation, opening up new avenues for engaging with and disseminating the rich tapestry of human history and artistic expression. The result is a harmonious blend of technology and artistry, paving the way for future explorations into the vast potential of digital spaces to honour and celebrate our cultural legacies.

4.2. Usage and Operation of Midjourney

To use Midjourney, creators typically input descriptive prompts into the system. These prompts can range from simple descriptive words to complex, detailed sentences outlining specific elements, styles, and moods desired in the output image. Midjourney then processes these prompts through its neural network to generate images that align with the given descriptions.

The basic command structure for generating images with Midjourney is intuitive, typically requiring users to engage with a chatbot interface, often accessible via platforms like Discord. Users can input commands such as /imagine followed by a text prompt that describes the visual content they wish to create. There are also parameters to refine the output, like adjusting style and detail or referencing art movements or artists pre-1912.

4.2.1. Cost

The cost of using a service like Midjourney can vary. Often, a tiered subscription model ranges from free trials with limited usage to premium plans offering more flexibility, higher resolution outputs, and commercial usage rights. The service provider sets the specific costs, which may change, so reviewing the latest pricing models offered by Midjourney or similar AI image generation services is advisable.

4.2.2. Advantages

The use of neural networks for image generation comes with significant advantages:

- **Efficiency**: Rapid generation of a wide range of visual concepts without requiring extensive manual artwork.
- **Creativity**: The AI can produce creative interpretations that might not have been conceived otherwise.
- **Customization**: Flexible prompts allow for a high degree of customization in the visual output.
- **Accessibility**: Offers creators the ability to generate art from anywhere, requiring only textual input and an internet connection.
- **Large-Scale Production**: Can create multiple image variations at once, useful for large projects needing a variety of visuals.

4.2.3. Disadvantages

Conversely, there are disadvantages to consider:

- **Dependency on Input:** The AI's output is only as good as the input it receives. Crafting the right prompts requires skill and practice, which can be a significant learning curve for users.
- **Contextual Understanding:** Midjourney may not fully grasp historical context or cultural nuances, potentially leading to images that don't accurately reflect the intended era or cultural details.
- **Cost:** Access to Midjourney's full capabilities might come with a price, which could be a consideration for projects with limited budgets.
- **Quality Control:** The lack of human touch can sometimes result in images that may require significant post-processing to meet quality standards.

4.2.4. Basic Commands and Parameters

Midjourney operates with a series of prompts and parameters that guide the AI in generating images. While the specifics can vary based on the exact version of the software or platform you are using, here's a general overview of the types of commands and parameters you might use:

- **Prompt Crafting**: The command line typically starts with a prompt describing the image you want to generate. For instance, "a Viking warrior in battle" or "a serene Nordic landscape at dusk."
- **Style Parameters**: You can specify the style of the artwork by adding keywords like "photorealistic," "oil painting," or "watercolor" to guide the AI toward your desired visual style.
- **Resolution Parameters**: Some platforms allow you to set the resolution of the output image with commands that might look like `--res 1024x1024` to set a specific pixel dimension.
- **Aspect Ratio**: Adjusting the aspect ratio can be as simple as appending `--ar 16:9` to your command, ensuring the generated image fits a certain size format.
- **Iterations and Variations**: Commands like `--v ` followed by a number can control the number of variations the AI should produce, offering different takes on the same prompt.

4.3. Meshy AI: Creation of 3D Models for Virtual Exhibits

Meshy AI, a neural network-based platform, stands at the forefront of converting two-dimensional imagery into fully realized three-dimensional models. It employs a type of artificial intelligence known as a convolutional neural network (CNN), renowned for its efficacy in analyzing visual imagery. The intricate and fascinating process relies on the AI's ability to discern depth and texture from flat images to construct detailed 3D structures.

In practice, Meshy AI takes inputs such as photographs, detailed sketches, or paintings of objects and artefacts. It then interprets these inputs through its neural network to generate 3D models that maintain the textures and contours of the original images. This conversion is particularly advantageous for projects like virtual museums, where historical accuracy and visual detail are paramount. The AI parses the shading, line work, and perspective in the images to extrapolate a three-dimensional form. This approach is not merely an act of replication but a sophisticated form of digital inference, where the AI fills in the gaps of what a 3D object should look like based on the 2D input it receives. For the "Scandinavian Mythology in Digital Space" exhibit, Meshy AI could be tasked to create a series of models that capture the essence of Viking culture. Examples of potential 3D models include:

- **Reconstructions of Viking Artifacts:** Inputting images of historical Viking artefacts could lead Meshy AI to generate detailed 3D replicas suitable for close inspection within the virtual museum environment.

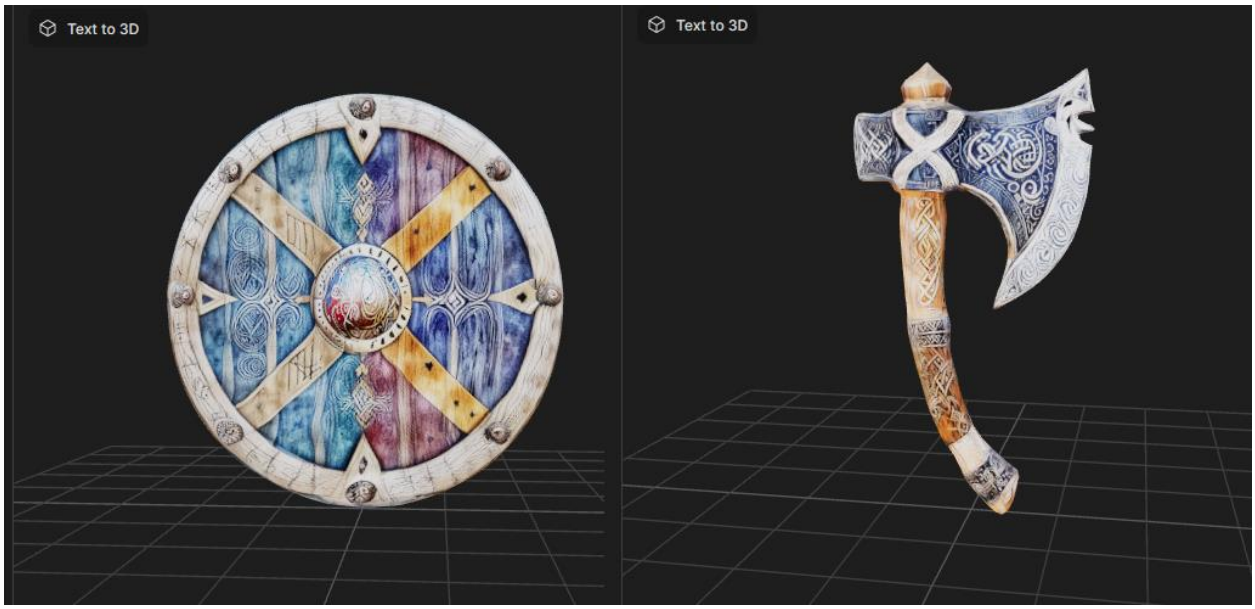

Figure 8. *AI-generated 3D models of a Viking shield and axe, exemplifying the intricate detailing possible with Meshy AI for virtual exhibit creation.*

- **Architectural Elements:** By feeding the AI images of Norse architecture, such as longhouses or stave churches, Meshy AI can create textured, structurally sound models that visitors can explore.

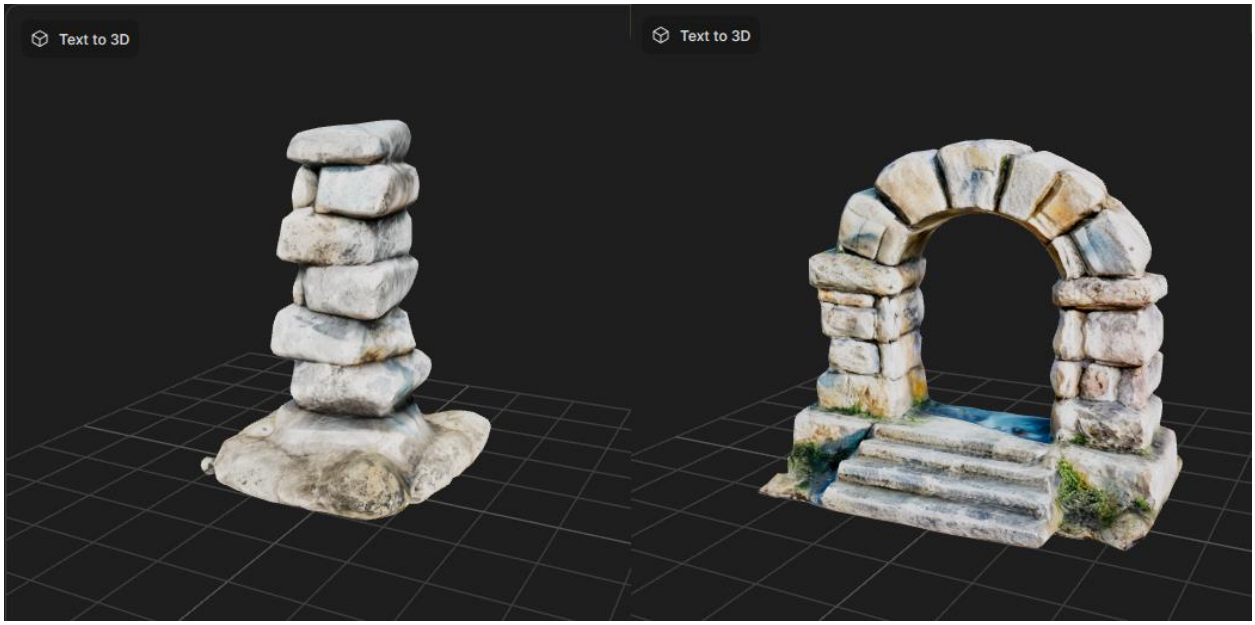

Figure 9. *AI-generated 3D models of a traditional Norse cairn and stone archway, crafted to add authentic elements to the virtual landscape.*

- **Mythological Figures:** Illustrations of mythological beings like giants, dwarfs, and creatures from the sagas can be transformed into three-dimensional models, providing a tangible form to the mythic narratives.

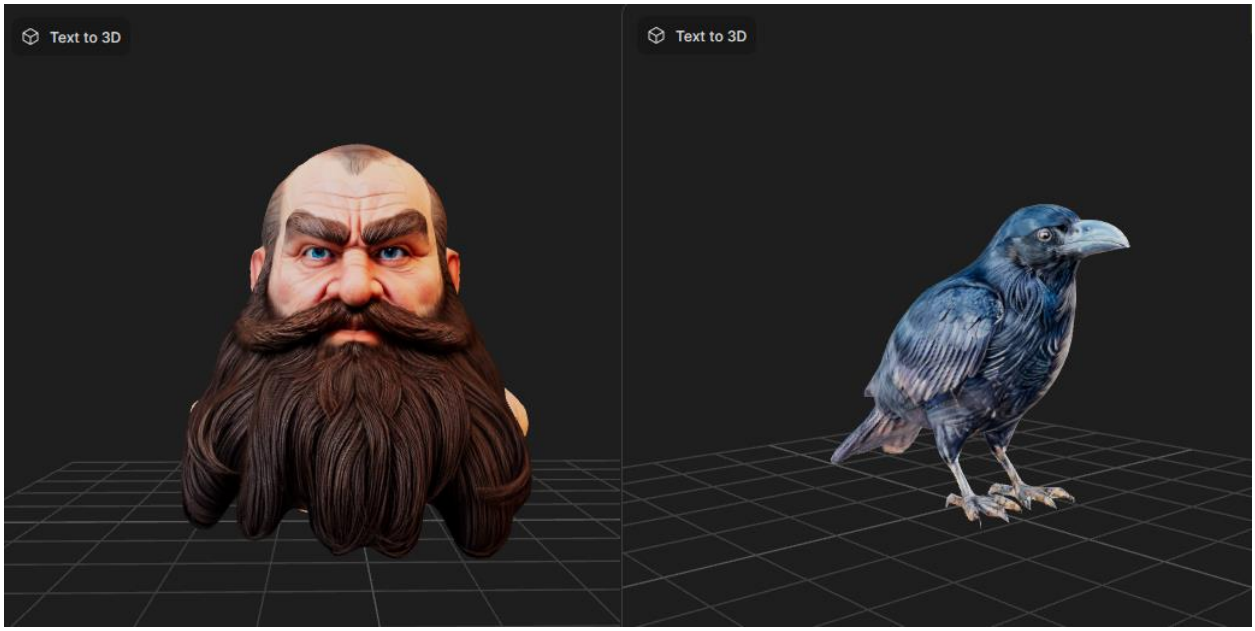

Figure 10. *AI-generated 3D models featuring a Norse dwarf and one of Odin's ravens, realized with intricate detail for virtual exhibit enhancement.*

Combining Meshy AI-generated models into a virtual environment crafted with Unreal Engine 5, which harnesses the engine's full rendering power, breathing life into the models with dynamic lighting, shadow casting, and realistic environmental interactions. This blend of AI-generated content with advanced rendering capabilities offers visitors an engaging and interactive way to experience historical and cultural narratives, making exploring Norse mythology an immersive journey.

Meshy AI's utility in cultural heritage projects stems from its ability to streamline the modelling process. Traditionally, creating detailed 3D models is time-consuming and requires specialized skills. Meshy AI simplifies this process, allowing for rapid prototyping and iteration, which is invaluable for projects with vast scopes or limited timelines.

4.4. Usage and Operation of Meshy

Using Meshy AI is a straightforward process designed with user accessibility in mind. To begin, users upload their two-dimensional images to the platform, ranging from photographs to hand-drawn sketches. The AI then prompts the user for any necessary annotations or additional input that can assist in the 3D modelling process, such as identifying the edges of an object or indicating the direction of light in a scene. This interactive step ensures that Meshy AI has all the context to interpret the image accurately. Once the initial setup is complete, Meshy AI generates a 3D model based on the input. Users can then review the model, make adjustments or provide further input. The platform typically allows for iterations, enabling users to refine the model until it meets their specifications. After finalizing the model, it can be exported in various formats compatible with 3D rendering software or game engines like Unreal Engine 5, ready to be integrated into virtual environments or interactive exhibits.

4.4.1. Cost

The cost structure for Meshy AI, like many AI services, can vary based on the project's specific needs, such as the number of models to be generated, the complexity of the images, and the level of detail required. The platform operates on a subscription-based or pay-per-use basis, with different tiers accommodating the usage scale from individual hobbyists to large-scale commercial enterprises. For academic and cultural institutions, discounted or subsidized pricing may be available, making it a cost-effective solution for projects aiming to digitally preserve and present historic artefacts and sites.

4.4.2. Advantages

Meshy AI offers a suite of advantages for creators and educators in the field of cultural heritage:

- **Efficiency:** The AI significantly speeds up the modelling process, translating images into 3D models much faster than traditional methods.
- **Ease of Use:** Meshy AI features a user-friendly interface, making the transition from 2D to 3D accessible for users without extensive 3D modelling experience.
- **Scalability:** Meshy AI's system can handle large quantities of images, making it scalable for projects of varying sizes, from individual exhibits to entire virtual museums.
- **Integration:** The 3D models produced are compatible with significant rendering and game engines, facilitating their integration into virtual environments.

4.4.3 Disadvantages

While Meshy AI is a powerful tool for creating 3D models, there are some disadvantages to consider:

- **Accuracy Limitations:** AI may only sometimes interpret the 2D images correctly, leading to inaccuracies in the 3D models that require manual correction, especially where intricate details or complex textures are present.
- **Quality Control:** The output quality can vary, necessitating a review and possible manual refinement to ensure that models meet the desired standards of precision and realism.
- **Processing Time:** The conversion process can be time-intensive for complex images, potentially slowing down workflows.
- **Dependency on Image Quality:** The effectiveness of AI heavily depends on the quality of the input images; poor-quality images can lead to poor-quality models.
- **Costs:** While cost-effective in many scenarios, the pricing model can disadvantage small projects or individual users with limited budgets, especially if high-resolution models are required.

5. DESIGNING THE VIRTUAL MUSEUM

5.1. Conceptualizing the Virtual Space with Unreal Engine 5

The virtual exhibition, "Scandinavian Mythology in Digital Space," is conceived as an immersive trail set within a forested gorge where time appears to stand still, encapsulating the visitor in an unbroken continuum of the past. This virtual trail is not merely a pathway but a narrative journey bridging two profound aspects of Scandinavian legacy: mythology and the Viking Age.

The Mythological Left: On the left, the path is flanked by rich tableaus depicting the grandeur of Scandinavian myths. Here, visitors are invited to engage with scenes and characters wrought from legend, rendered in stunning visual detail. Each step along this part of the trail reveals 3D models and art pieces that act as portals into the stories of gods and heroes, giants and mythical beasts, each accompanied by interactive elements designed to educate and captivate.

The Historical Right: To the right, the trail mirrors the left with representations from the Viking Age. Artefacts, war gear, and everyday items are presented in their historical context, allowing visitors to explore the material culture of the Vikings. Through the artistry of Unreal Engine 5, each artefact resonates with life, inviting an intimate examination as if one were walking through an ancient Viking settlement.

Interactive Engagement: The journey through the virtual space is self-guided, granting visitors the autonomy to pause and explore at their own pace. 3D models and visual art are complemented by audio narratives that activate with interaction, offering stories that delve into the history and significance of the objects. This multimedia approach caters to various learning styles and ensures that each visitor's experience is informative and sensorially rich.

Audio Stories: The audio narratives serve a dual purpose: they provide context and background for the artefacts and myths and enhance the trail's immersive experience. Using spatial audio techniques within Unreal Engine 5 allows these stories to emanate from their respective objects, giving a sense of presence and location as if the artefacts are whispering their histories to the listeners.

The conceptualization of this virtual museum trail leverages the visual and auditory capabilities of Unreal Engine 5 to create a space where history and mythology coalesce. It is a place that is both a tribute to the Scandinavian past and a showcase of contemporary digital storytelling, offering visitors an educational experience that is profound, personal, and palpable.

Figure 11. *Early stage UE5 screenshot capturing the nascent landscape and foundational trail layout for the virtual museum pathway.*

Figure 12. *A progressive stage in UE5 development showcasing the evolving trail set amidst a rugged Norse landscape, hinting at the immersive journey that awaits visitors.*

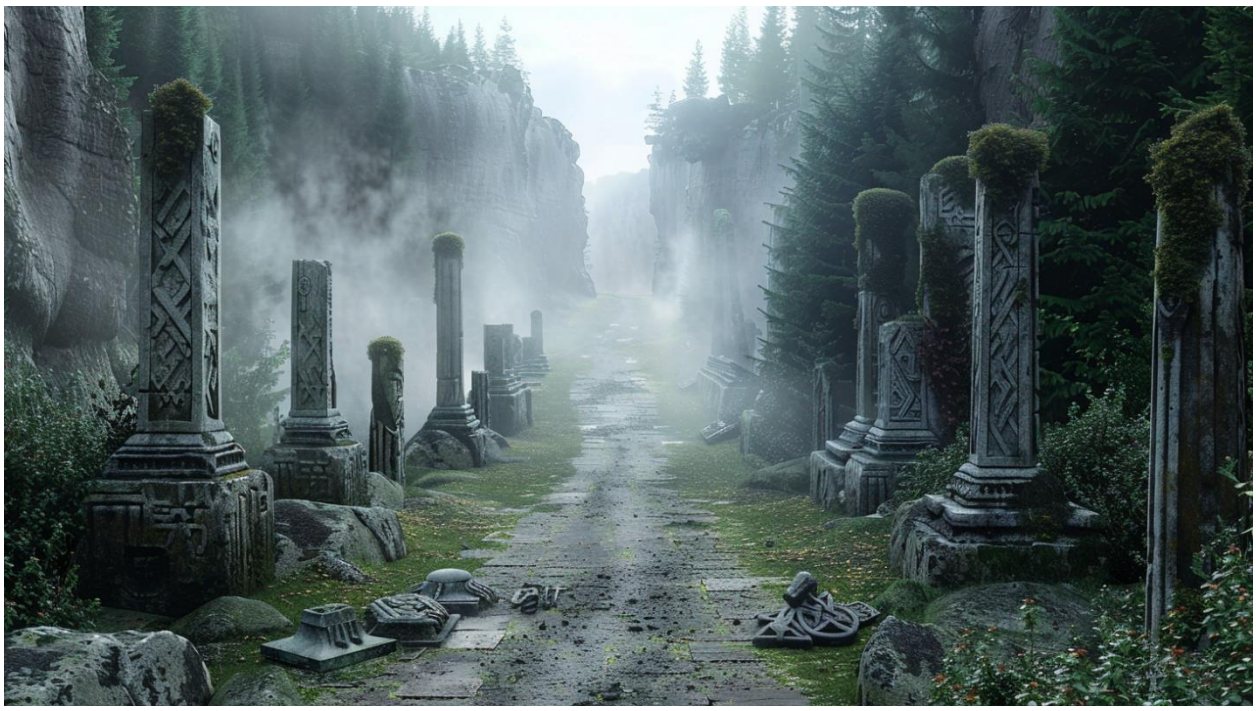

Figure 13. *A Midjourney generated concept-art depicting an atmospheric forest path flanked by ancient Norse runestones, capturing the enigmatic spirit of the myths it represents.*

The project's progression, from initial landscape creation to the integration of detailed artistic renditions, encapsulates the transformative potential of combining advanced rendering technology with AI-generated art. The provided figures transition from a bare trail to a pathway bordered by culturally rich runestones, evidencing a thoughtful curation of Norse heritage. This virtual museum not only stands as an innovative approach to digital preservation but also a testament to the intricate storytelling made possible through contemporary technology. The artefacts and environments, steeped in historical resonance, are set to offer visitors an immersive educational encounter with the Viking Age and its myths.

5.2. Visual and Technical Considerations

As I delve deeper into the development of the virtual exhibition, my engagement with Unreal Engine 5's capabilities intensifies. I am combining the high-fidelity scanned models sourced from Quixel Bridge with the native prowess of UE5, crafting an environment that resonates with authenticity and atmosphere.

The lighting, a critical element in this digital curation, is carefully adjusted to exude a slight coolness—a deliberate choice to mirror the crisp Nordic climes. This excellent lighting sets the visual tone and highlights the textures of the landscape and artefacts, ensuring that the essence of Scandinavian environments is palpably felt. The attention to color temperature is not merely aesthetic but a technical endeavor to ensure the light complements the exhibit's thematic content and enhances the user's sensory experience.

In tandem with these efforts, I am meticulously creating a bespoke volumetric fog material. I manipulate parameters through UE5's material editor to achieve the perfect balance of visibility and obscurity, simulating the dense, creeping fogs characteristic of Scandinavian folklore settings. This fog serves a dual purpose: it heightens the aura of mystery that envelops Norse legends while providing a practical visual layer that aids in depth perception within the virtual space.

Utilizing Post Process Volume is another critical aspect of my current work. This tool allows me to influence the mood and tone of the environment subtly. By tweaking settings such as exposure, contrast, and saturation, I instill a sense of the ethereal—a touch of the otherworldly that befits the mythological subject matter. This process is iterative, with each adjustment bringing me closer to achieving a delicate balance between reality and myth.

Lighting within the virtual space is placed with intentionality. I am not just illuminating the gorge and its artefacts; I am sculpting the exhibit with light. Each ray is positioned to cast just the right amount of shadow and highlights, ensuring that the artefacts beckon with an inviting clarity. The lighting design is technical and narrative, leading the visitor's gaze to points of interest and helping to tell the stories of the items on display.

My current efforts encapsulate the very essence of what it means to create an immersive virtual museum: a place where the past is not only seen but felt, where every visual and technical decision is a brushstroke in a larger painting, one that, when stepped back, reveals a vibrant tableau of Scandinavian history and mythology brought to life through the digital alchemy of Unreal Engine 5.

6. PROJECT STRATEGY / DEVELOPMENT

6.1. Research and Data Collection on Norse Mythology

In developing the virtual exhibition I undertook a methodical research and data collection approach, focusing on the central figures and narratives that form the backbone of Norse mythology. Recognizing time constraints, it was imperative to distil the vast mythology into its most iconic elements, ensuring that the virtual museum would offer a comprehensive yet focused exploration of the topic.

The initial data collection stage involved a thorough review of primary texts, such as the "Poetic Edda" and "Prose Edda," which are seminal to understanding Norse mythology. These ancient compilations provide invaluable insights into the gods, the world's creation, and the foretold events of Ragnarok. To complement these primary sources, secondary literature, including scholarly analyses and interpretations, was consulted to gain contemporary perspectives and to ensure a multifaceted understanding of the myths.

To present a balanced view that blends the mythical with the historical, I divided the museum's content into two main sections: one dedicated to Scandinavian mythology and the other to the Viking Age. This division allowed for a clear contextual framework where visitors could engage with legendary tales and historical artefacts that reflect the era's cultural reality.

Online databases and digital libraries proved to be instrumental in accessing a wide array of academic papers and books, which were meticulously vetted for credibility and relevance. Websites such as JSTOR, Project MUSE, and university-hosted repositories were frequented for up-to-date research findings and interpretive theories.

As for the collection of visual and cultural data, museums with substantial Norse collections, such as the National Museum of Denmark and the Viking Ship Museum in Oslo, offered digital archives and exhibits that were carefully examined. These resources provided factual and visual data that informed the creation of accurate 3D models and immersive storylines for the virtual exhibits.

The research and data collection process was an intricate blend of traditional academic rigour and modern digital exploration. The methodology was structured yet adaptive, allowing for the curation of authoritative and engaging content.

6.1.1. Main Characters Of Myths

The virtual exhibition prominently features critical characters from Norse mythology, each with their unique narratives and significance:

- **Odin:** The Allfather, chief of the gods, associated with wisdom, poetry, and war. Odin's quest for knowledge and sacrifices are central themes in Norse mythology.
- **Frigg:** Odin's wife, the goddess of love, marriage, and destiny. Known for her foresight and wisdom, Frigg is a central maternal figure.
- **Thor:** The god of thunder, known for his strength and mighty hammer, Mjölnir. Thor is a protector of humanity and a symbol of physical prowess.
- **Balder:** The beloved god of beauty, innocence, and joy. His tragic death is one of the most poignant tales and is a crucial event leading up to Ragnarök.
- **Heimdall:** The watchman of the gods who guards the Bifrost Bridge. Heimdall possesses keen senses and is known for his vigilance and loyalty.
- **Mimir:** The wise god whose head was preserved by Odin after the Aesir-Vanir War. Mimir's well of wisdom is sought by those seeking knowledge.
- **Loki:** A trickster god with the ability to shape-shift. Loki's mischievous and sometimes malevolent actions have significant consequences for the gods and the world.
- **Skoll and Hati:** Two wolves who chase the sun and the moon, respectively. Their pursuit is said to lead to celestial eclipses and eventually to Ragnarök.
- **Huginn and Muninn:** Odin's two ravens, whose names mean "thought" and "memory." They fly across the world daily, gathering information for Odin.
- **Fenrir:** A monstrous wolf, prophesied to kill Odin during Ragnarök. Fenrir's bound form and eventual breaking free are critical elements in the myths.

These characters form the backbone of the mythology section of the museum, each represented by a combination of visual and auditory exhibits to bring their stories to life within the virtual space.

6.1.2. 9 Realms Of Scandinavian Mythology

In Norse cosmology, the universe is structured around the World Tree, Yggdrasil, a great ash tree that connects nine distinct realms, each home to various beings and gods. These realms are central to mythology and form a complex system of interrelated dimensions that are explored throughout the virtual exhibition:

- **Alfheim:** The realm of the Light Elves, beings associated with beauty and light. Alfheim is depicted as a place of tranquillity and natural beauty within the exhibition.
- **Asgard:** The home of the Aesir gods, including Odin and Thor. Asgard is a fortified realm where the gods dwell in majestic halls, such as Valhalla and Odin's hall of the slain warriors.
- **Helheim:** Often simply called Hel, this is the realm of the dead who did not die a heroic or notable death. Governed by the goddess Hel, it is depicted as a sombre and misty place.
- **Jotunheim:** The ice land of the giants, or Jotnar. This realm is characterized by rugged mountains and dense forests, a wild and untamed land opposing the order of Asgard.
- **Midgard:** The world of humans is physically connected to Asgard via the rainbow bridge, Bifrost. Midgard is central to many Norse myths involving interactions between gods and mortals.
- **Muspelheim:** The realm of fire, home to fire giants and demons. It is a place of intense heat and flames, often depicted as a volcanic and inhospitable landscape.
- **Nidavellir:** The realm of the dwarves, master artisans and metalworkers, known for their underground cities and forges. It is a realm of remarkable craftsmanship and ingenuity.
- **Niflheim:** A cold and misty realm of ice and frost, often considered the opposite of Muspelheim. Niflheim is associated with darkness and cold, the origin of all cold in the universe.
- **Vanaheim:** The home of the Vanir gods, associated with fertility, prosperity, and sea-faring. Vanaheim is often depicted as a lush and fertile land.
- **Yggdrasil:** The great ash tree that connects all the realms together. Its branches and roots extend into each realm, stabilizing the cosmos. Yggdrasil is a central figure in Norse cosmology, essential for the universe's structure.

6.1.3. Viking Age

The Viking Age section of the virtual exhibition vividly brings to life the era known for its seafaring warriors, traders, and explorers. This part of the museum is dedicated to showcasing the material culture of the Vikings, emphasizing their tools of war, daily life, and maritime innovations. Here's an overview of the critical exhibits:

- **Daggers**: Vital for close combat and daily tasks, Viking daggers were both utilitarian and symbolic, often richly decorated to reflect the status of their owner.
- **Swords**: The quintessential symbol of Viking warrior culture, these swords are displayed in full glory, with attention to the detailed patterns on the blades known as "pattern welding." Swords were highly prized possessions, often given names and passed down through generations.
- **Axes**: Perhaps the most iconic Viking weapon, axes ranged from simple tools to elaborate weapons explicitly designed for battle. The exhibition showcases different types of axes, demonstrating their versatility and importance in Viking society.
- **Spears**: Spears were used both as throwing weapons and for thrusting in battle and shared among Viking warriors. The exhibit explains the techniques of spear warfare and its role in Viking battle strategies.
- **Shields**: Essential for protection, Viking shields were functional and ornate, often painted with intricate designs. The shields on display highlight the artistry and strategic design, including the iconic round shape used in shield walls during combat.
- **Viking Clothing and Armor**: This section provides insight into the daily life and social status reflected through clothing and armour. From simple woollen garments to complex leather and mail armour, the exhibit covers the variety of materials and styles used in the Viking Age.
- **Viking Drakkars**: The longships, or drakkars, are central to the Norse exploration and raiding narrative. Models and interactive displays allow visitors to explore these ships' sophisticated design and engineering, which were instrumental in Viking voyages across the seas.
- **Mini Installation of a Viking Village**: To give visitors a comprehensive view of Viking daily life, a detailed miniature Viking village is recreated within the exhibition. This installation includes dwellings, workshops, and communal spaces populated with figures engaged in various activities, from crafting to cooking, providing a dynamic and engaging portrayal of Viking community life.

6.2. Generating Visuals and Models with Midjourney and Meshy AI

Creating immersive visuals and detailed 3D models for the "Scandinavian Mythology in Digital Space" virtual museum involved the strategic use of two advanced AI platforms: Midjourney for generating artistic visuals and Meshy AI for creating accurate 3D models. Here is a detailed look at how each technology was utilized:

Midjourney: Generating Artistic Visuals

The process with Midjourney began by formulating precise prompts that encapsulated the essence of the mythological concepts I wanted to represent visually. These prompts were crafted to align with the mythological themes of the exhibition, incorporating descriptive adjectives and contextual details to guide the AI towards producing the desired artistic style and mood.

- **Prompt Creation**: For instance, to create an image of Odin, the prompt might include descriptions such as "ancient Norse god, wise and majestic, seated in a grand throne, surrounded by the misty ambience of Asgard, in a mythical painting style." This specificity in the prompts helped guide Midjourney to generate visuals that captured not only Odin's physical attributes but also his mystical qualities.
- **Style Specifications**: The style of the visuals was critical to conveying the right atmosphere. I experimented with different art styles through Midjourney, such as watercolor for ethereal effects and digital painting for crisp, vivid details. Each style was selected based on how well it complemented the narrative of the particular mythological story or artefact being depicted.
- **Iterative Feedback**: Generating the final visuals was an iterative process. Initial outputs from Midjourney were reviewed, and adjustments were made to the prompts based on the visual feedback. This iterative process ensured the visuals met aesthetic expectations and were culturally and historically resonant.

There`s some of creation examples:

Object: Drakkar

Prompt: fresco art, Scandinavian mythology, drakkar-boat, ship --ar 9:16

Result:

Figure 14. *A collection of artistic interpretations of Viking longships, generated by Midjourney from descriptive prompts.*

Object: Loki

Prompt: fresco art, young man Loki, sly look, Norse mythology, long black flowing hair, a helmet with two horns, mostly green clothes, gray background --ar 9:16

Result:

Figure 15. *Variations of the character Loki as envisioned by Midjourney, based on textual prompts highlighting his cunning and complex nature.*

Meshy AI: Creating 3D Models from Text

Meshy AI's text-to-3D model generation capability was pivotal in transforming detailed narrative descriptions into accurate 3D models:

- **Model Generation from Text**: Instead of relying on 2D images, Meshy AI was used to interpret detailed textual descriptions of Viking artefacts and elements of Norse environments. Descriptions such as "a detailed Viking longship with intricately carved dragon heads and a sturdy oak build" were input into Meshy AI to generate precise 3D models.

- **Technical Specifications**: I specified parameters such as texture detail, model scale, and complexity directly in the textual input, guiding Meshy AI to produce models that met specific visual and technical requirements.

- **Model Refinement and Integration**: The initial 3D models generated by Meshy AI were imported into Unreal Engine 5 for further refinement. Adjustments were made to enhance textures, optimize materials, and ensure compatibility with the virtual environment's interactive elements.

- **Testing and Adjustment**: Each model underwent rigorous testing within the virtual trail setting to ensure they interacted seamlessly with the environment, including lighting, shadow, and interactive scripts.

There`s some of creation examples:

Object: Bust of Loki

Prompt: Loki, God of deceit, horns, Stone Statue, Nordic Mythology, Only Stone texture

Result:

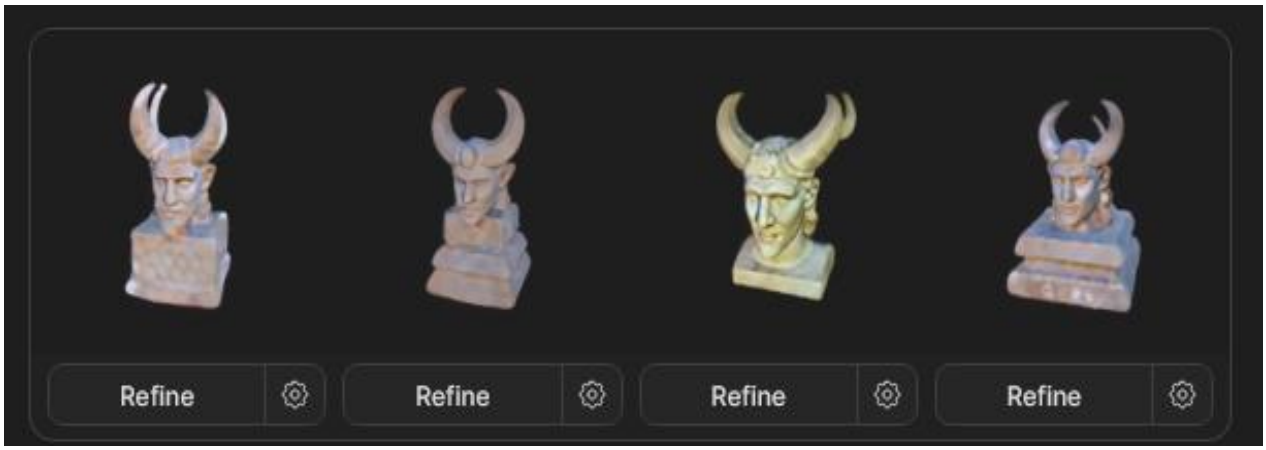

Figure 16. *A series of AI-generated 3D busts of Loki.*

Object: Bust of Thor

Prompt: Stone bust of Thor, with Helmet, Stone Texture

Result:

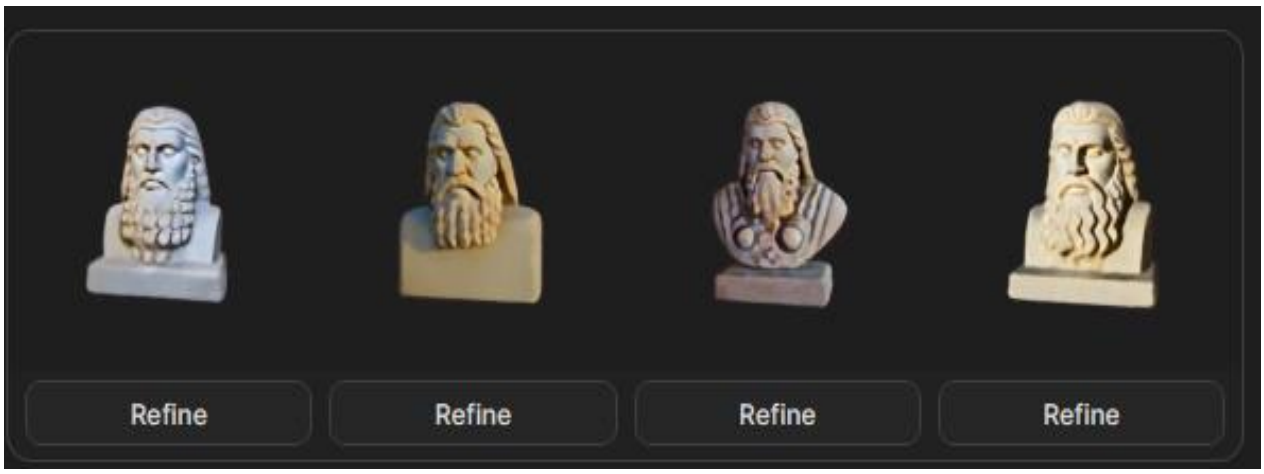

Figure 17. *A series of AI-generated 3D busts of Thor.*

6.3. Integration of AI-generated Content

The integration of AI-generated content within Unreal Engine 5 streamlined the construction of the virtual exhibition. This process was characterized by a smooth transition of assets from the AI platforms to the game engine, ensuring a seamless workflow from conception to implementation.

Meshy AI Model Integration

The 3D models generated by Meshy AI were downloaded in the widely compatible .obj format, which Unreal Engine 5 readily supports. This standardization simplified the import process:

1. **Model Acquisition**: Following the AI's generation and refinement process, the finalized 3D models were exported from Meshy AI as .obj files, which include the mesh and associated texture mappings.
2. **Drag and Drop**: Using the intuitive interface of UE5, I implemented a simple 'drag and drop' method to transfer the .obj files directly into the project's content folder. This ease of file transfer significantly expedited the setup phase for each model.
3. **Asset Check**: Once imported, the models appeared in the UE5 content browser, where I performed a quick inspection to ensure the integrity of the models and their textures.
4. **Scene Placement**: The 3D models were then placed within the virtual environment. I utilized UE5's transformation tools to position, scale, and rotate each model, meticulously embedding them into the designed scenes and landscapes.

Midjourney Visuals Integration

Similarly, the integration of visuals created with Midjourney maintained a straightforward approach:

1. **Image Export**: The artistic renderings from Midjourney were saved as high-resolution .png images, preserving the quality and transparency needed for the exhibition.
2. **File Transfer**: These .png files were then imported into Unreal Engine 5 via the same drag-and-drop functionality, a testament to the engine's user-friendly design for asset management.
3. **Material Creation**: Within UE5, I created materials for each image, which allowed me to enhance further the visuals with effects such as reflections, gloss, and ambient occlusion, tailoring the images to their respective settings within the exhibit.

4. **Exhibit Application**: The images were applied to geometry within the environment, such as standing displays or interactive screens, where visitors could approach and engage with the visuals.

Figure 18. *A 3D model imported into Unreal Engine 5 from Meshy AI, showcasing the integration of AI-generated content into the virtual environment.*

Figure 19. *A Midjourney-created art piece of Loki, seamlessly integrated within the Unreal Engine 5 landscape, enhancing the narrative atmosphere of the virtual exhibit.*

6.4. Development Process Using Unreal Engine 5

The development of the project involved an extensive exploration and application of Unreal Engine 5's capabilities. As I embarked on this project, my initial step was to familiarize myself with Unreal Engine 5 (UE5), leveraging its comprehensive documentation and resources to understand its vast toolset and features.

Learning and Experimentation:

The development process began with a phase of learning and experimentation, where I dedicated time to studying UE5's documentation and engaging with the community through forums and tutorials. This phase was crucial in gaining a deep understanding of the engine's core functionalities, including its advanced rendering system, asset management tools, and interactive features. I also explored various plugins and extensions that could enhance the visual and interactive quality of the virtual museum.

Environment Setup:

Once familiar with the tools, I started setting up the virtual environment. This involved laying out the basic terrain using UE5's landscape tools and then integrating scanned models from Quixel Bridge to populate the scene with natural elements reflective of a Scandinavian landscape. The environment setup was a meticulous process, ensuring that each element, from terrain textures to foliage, was optimized for performance while maintaining high visual fidelity.

Asset Integration:

Simultaneously, I began integrating 3D models and artifacts into the environment. Each model, whether sourced from Meshy AI or created through traditional 3D modeling techniques, was carefully placed within the virtual space. This step was complemented by creating custom materials and textures in UE5, enhancing the realism of historical artifacts and thematic elements.

Interactive and Narrative Elements:

To enrich the visitor experience, I integrated interactive elements using UE5's Blueprints visual scripting system. This allowed me to embed interactive audio narratives and clickable information points throughout the trail. Each interactive point was designed to provide historical insights or mythological stories, enhancing the educational value of the exhibit.

Lighting and Atmospheric Effects:

A significant portion of the development focused on lighting and atmospheric effects to set the right mood and tone for the exhibition. I employed UE5's Lumen for dynamic global illumination, which adapted the lighting based on the time of day and weather conditions simulated in the environment. Additionally, I crafted custom volumetric fog effects to add a mystical ambiance to the Norse mythology section, enhancing the visual narrative.

Testing and Iteration:

Throughout the development process, continuous testing and iterations were conducted to refine user interactions and visual elements. This involved regular playtesting sessions to make adjustments, ensuring that the virtual museum was both user-friendly and historically accurate.

Final Adjustments:

In the final stages, I focused on optimizing the entire virtual museum for various platforms to ensure accessibility and smooth performance. This included fine-tuning the graphics settings, streamlining asset loading, and ensuring that the interactive elements functioned seamlessly across different devices.

Figure 20. *The final in-game screenshot from Unreal Engine 5, showcasing the entrance to the virtual exhibition with sections marked for 'Scandinavian Myths' and the 'Viking Age', inviting visitors to embark on a historical and mythological journey.*

7. SUMMARY OF CONTRIBUTIONS

7.1. Assessment of Unreal Engine 5's Role

Unreal Engine 5 (UE5) was crucial in developing the virtual exhibition "Scandinavian Mythology in Digital Space." Key features such as Nanite virtualized geometry and Lumen global illumination were instrumental in creating highly detailed and immersive environments. Nanite allowed for intricate designs of Norse artefacts without sacrificing performance, while Lumen provided dynamic, realistic lighting that enhanced the atmospheric quality of the exhibition.

Integrating Quixel Bridge and its extensive Megascans library streamlined the import of high-quality, photorealistic assets, ensuring visual consistency and saving development time. Volumetric fog and particle effects added depth and a mystical ambience, crucial for depicting the mythical aspects of Scandinavian mythology.

UE5's Blueprints visual scripting system enabled the development of interactive elements, such as clickable information spots and audio narratives, enriching the user experience with contextual information and stories. UE5's support for virtual reality (VR) also opens up future possibilities for further immersive experiences.

In summary, Unreal Engine 5's advanced graphical capabilities and user-friendly tools were essential in creating a detailed, interactive, and immersive virtual exhibition, significantly enhancing the project's educational and aesthetic quality.

7.2. Evaluation of AI Tools in Creating Museum Content

AI tools, specifically Midjourney and Meshy AI, played a vital role in developing the virtual exhibition "Scandinavian Mythology in Digital Space." Midjourney generated high-quality images of Norse mythology scenes and figures, while Meshy AI created 3D models of artefacts and characters from textual descriptions. These tools significantly expedited the content creation, allowing for rapid production and refinement of visuals and models.

Midjourney's images were used as textures and display panels, and Meshy AI's models were incorporated as interactive 3D objects within Unreal Engine 5. The integration was seamless, enhancing the exhibition's visual appeal and interactivity.

The main advantages of using AI tools included increased efficiency and reduced dependency on specialized skills. However, ensuring historical and cultural accuracy required careful, prompt selection and iterative refinements. Final validation against scholarly sources was necessary to maintain content integrity.

In summary, AI tools like Midjourney and Meshy AI significantly improved the efficiency and quality of content creation for the virtual exhibition while requiring careful management to ensure accuracy and relevance.

CONCLUSION

In this thesis, I set out to create a virtual exhibition titled "Scandinavian Mythology in Digital Space" using Unreal Engine 5. The primary goal was to develop an interactive, immersive digital environment showcasing Norse mythology and Viking history. I aimed to leverage advanced technologies, including AI tools like Midjourney and Meshy AI, to enhance the visual and educational quality of the exhibition.

The project successfully achieved its goals by integrating high-fidelity 3D models, dynamic lighting, and interactive elements within Unreal Engine 5. Using Nanite for detailed geometry and Lumen for realistic lighting significantly created an engaging atmosphere. AI tools like Midjourney and Meshy AI expedited the content creation, allowing for rapid production of high-quality images and 3D models. These elements combined to create a compelling virtual experience that brings Scandinavian mythology to life.

During the development process, several unexpected challenges arose. They ensured the historical and cultural accuracy of AI-generated content, which required more iterative refinement and validation against scholarly sources than initially anticipated. Additionally, optimizing the performance of high-fidelity assets within Unreal Engine 5 was a complex task that required careful balancing of detail and efficiency. These challenges highlighted the importance of combining AI capabilities with expert knowledge and technical proficiency.

New ideas also emerged throughout the project, such as the potential for expanding the exhibition into virtual reality (VR) to further enhance user immersion. This possibility opens up exciting future avenues for the project, allowing users to explore the virtual environment as if they were physically present.

In conclusion, the project demonstrated the effective integration of advanced digital technologies in creating a virtual museum. It showcased the potential of AI tools in content creation while emphasizing the need for historical accuracy and technical optimization. The methodologies and technologies developed have broad applications, suggesting promising possibilities for future digital heritage projects. Plans are in place to continually refine the exhibition, enhancing its educational and interactive elements.

RESÜMEE

Käesolevas lõputöös võtsin eesmärgiks luua Unreal Engine 5 abil virtuaalnäituse pealkirjaga "Skandinaavia mütoloogia digitaalruumis". Esmane eesmärk oli arendada välja interaktiivne, kaasahaarav digitaalne keskkond, mis tutvustaks skandinaavia mütoloogiat ja viikingite ajalugu. Minu eesmärk oli kasutada arenenud tehnoloogiaid, sealhulgas AI tööriistu, nagu Midjourney ja Meshy AI, et parandada näituse visuaalset ja harivat kvaliteeti.

Projekt saavutas edukalt oma eesmärgid, integreerides Unreal Engine 5-sse kõrgtäpsusega 3D-mudelid, dünaamilise valgustuse ja interaktiivsed elemendid. Nanite'i kasutamine üksikasjaliku geomeetria ja Lumen'i kasutamine realistliku valgustuse jaoks lõi märkimisväärselt kaasahaarava atmosfääri. Tehisintellekti tööriistad, nagu Midjourney ja Meshy AI, kiirendasid sisu loomist, võimaldades kiiresti toota kvaliteetseid pilte ja 3D-mudeleid. Need elemendid ühendati, et luua mõjuv virtuaalne kogemus, mis äratab Skandinaavia mütoloogia ellu.

Arendusprotsessi käigus tekkis mitmeid ootamatuid väljakutseid. Need tagasid tehisintellekti loodud sisu ajaloolise ja kultuurilise täpsuse, mis nõudis algselt oodatust rohkem iteratiivset viimistlemist ja teaduslike allikate suhtes valideerimist. Lisaks oli Unreal Engine 5 kõrgtäpsusega varade jõudluse optimeerimine keeruline ülesanne, mis nõudis detailide ja tõhususe hoolikat tasakaalustamist. Need väljakutsed tõid esile AI-võimaluste kombineerimise olulisuse ekspertteadmiste ja tehniliste oskustega.

Projekti jooksul tekkisid ka uued ideed, näiteks potentsiaal laiendada näitust virtuaalreaalsuseks (VR), et veelgi suurendada kasutajate keelekümblust. See võimalus avab projekti jaoks põnevaid tulevikuvõimalusi, võimaldades kasutajatel virtuaalset keskkonda uurida nii, nagu oleksid nad füüsiliselt kohal.

Kokkuvõtteks demonstreeris projekt täiustatud digitehnoloogiate tõhusat integreerimist virtuaalse muuseumi loomisel. See tutvustas tehisintellekti tööriistade potentsiaali sisu loomisel, rõhutades samas vajadust ajaloolise täpsuse ja tehnilise optimeerimise järele. Väljatöötatud metoodikatel ja tehnoloogiatel on laialdased rakendused, mis viitavad paljutõotavatele võimalustele tulevaste digitaalse pärandi projektide jaoks. Plaanid on näitust pidevalt täiustada, täiustades selle harivaid ja interaktiivseid elemente.

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