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Design and Implementation of a Custom AI Chatbot on Digital Storytelling in a 3D Computer Graphics Scene

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Περίληψη

Οι άνθρωποι ανέκαθεν απολάμβαναν να μοιράζονται ιστορίες. Είναι ο πιο θεμελιώδης τρόπος με τον οποίο μαθαίνουμε, ενθαρρύνοντας τόσο την προσωπική σκέψη, όσο και τον δημόσιο διάλογο. Η αφήγηση ιστοριών είναι μια μέθοδος που χρησιμοποιείται ευρέως από ανθρώπους σε όλο τον κόσμο για συναισθηματική εμπλοκή, επικοινωνία και προβολή πολιτιστικών στοιχείων και προσωπικοτήτων. Επιπλέον, οι ιστορίες μας συνδέουν με προηγούμενες εμπειρίες και χτίζουν γέφυρες μεταξύ παρελθόντος και παρόντος. Στην ψηφιακή εποχή, η αφήγηση ιστοριών αντλεί την δύναμή της από τη συνδυαστική χρήση εικόνων, μουσικής, αφηγήσεων και φωνής, προσδίδοντας έτσι μια βαθύτερη διάσταση και ζωντανά χρώματα σε χαρακτήρες, καταστάσεις, εμπειρίες και αντιλήψεις. Οι υπολογιστές εμπλέκονται στη δημιουργία, αποθήκευση, αναπαραγωγή, διαμοιρασμό και δημοσίευση των ιστοριών αυτών.

Η παρούσα διπλωματική εργασία στοχεύει να διερευνήσει την ενσωμάτωση ενός προσαρμοσμένου AI Chatbot στον σχεδιασμό και την ανάπτυξη παιχνιδιών, με σκοπό την ενίσχυση της ψηφιακής αφήγησης. Εξετάζεται η σημασία της ψηφιακής αφήγησης ως ισχυρού εργαλείου για την εμπλοκή και την εμβύθιση του παίκτη, με έμφαση στη χρήση AI χαρακτήρων για τον εμπλουτισμό της εμπειρίας του παιχνιδιού. Η ψηφιακή αφήγηση μπορεί επίσης να εφαρμοστεί σε εκπαιδευτικό πλαίσιο, όπου η μάθηση μπορεί να ενισχυθεί μέσω της παιγνιοποίησης. Για να διερευνηθεί περαιτέρω η χρήση αυτής της τεχνολογίας στον τομέα των παιχνιδιών, η παρούσα εργασία στοχεύει στην υλοποίηση στοιχείων διεπαφής χρήστη (UI) και μηχανισμών για την αύξηση του επιπέδου διαδραστικότητας για τους χρήστες σε ένα παιχνίδι που τοποθετείται στο νησί της Γραμβούσας αναφορικά με τα γεγονότα που συνέβησαν κατά τη διάρκεια της Ελληνικής Επανάστασης (1821-1825 μ.Χ.).

Σε τεχνικό επίπεδο, η παρούσα διπλωματική εργασία επικεντρώνεται στην ενσωμάτωση της τεχνητής νοημοσύνης (AI) σε ένα σύστημα διαλόγου για χαρακτήρες μέσα σε ένα περιβάλλον παιχνιδιού, αξιοποιώντας το API του OpenAI. Το σύστημα αποθηκεύει τις απαντήσεις της τεχνητής νοημοσύνης σε ένα τοπικό αρχείο καταγραφής, επιτρέποντας στους χρήστες να έχουν πρόσβαση σε αυτές, με την πιο πρόσφατη απάντηση να είναι διαθέσιμη από προεπιλογή. Για την αξιολόγηση της ενσωμάτωσης, παρουσιάζονται διάφορες περιπτώσεις χρήσης, αναδεικνύοντας πτυχές της τεχνολογίας διαμόρφωσης προτροπών (prompt engineering) και συγκρίνοντας διαφορετικά μοντέλα GPT, εξετάζοντας τα πλεονεκτήματα και τα μειονεκτήματά τους. Επιπλέον, η εργασία διερευνά πώς αυτή η αλληλεπίδραση που βασίζεται στην τεχνητή νοημοσύνη μπορεί να συνδεθεί δυναμικά με το παραδοσιακό gameplay

αποστολών (quest-based gameplay), δημιουργώντας μια διαδραστική εμπειρία παιχνιδιού.

Abstract

Humans have always liked sharing stories. Storytelling is the most fundamental way we learn, encouraging both personal reflection and public discussion. It is a widely used method for people around the world to engage emotionally, communicate and project cultural elements and personalities. In addition, stories connect us with previous experiences and build bridges between the past and the present. In the digital era, storytelling gains its engaging power by integrating images, music, narratives, and voice, adding depth and vivid color to characters, situations, experiences, and insights. Computers are, of course involved in the creation, storage, reproduction, sharing, and publication of these stories.

This diploma thesis aims to investigate the integration of a custom-made AI chatbot in game design and development to enhance digital storytelling. The significance of digital storytelling as a powerful tool for player engagement and immersion is explored, with a focus on the use of AI characters to enrich the gaming experience. Digital storytelling can also apply in an educational context, where learning can be enhanced through gamification. To further explore the use of this technology in gaming, this project aims to implement UI elements and mechanics to increase the level of interactivity for users in a game set on Gramvousa Island occuring the events during the Greek War of Independence (1821-1825 AD).

At a technical level, this thesis focuses on integrating AI into a dialogue system for characters within a gaming environment, utilizing OpenAI's API. The system stores the AI's responses in a local log, allowing users to access them, with the most recent response being readily available by default. To evaluate this integration, various use cases are analyzed, highlighting aspects of prompt engineering and comparing different GPT models, discussing their advantages and limitations. Additionally, the thesis explores how this AI-driven interaction can dynamically connect with traditional quest-based gameplay, creating a more immersive and interactive gaming experience.

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Chapter 1

Introduction

1.1 Purpose of the Thesis

The primary purpose of this thesis is to investigate how artificial intelligence (AI) can enhance immersive experiences in digital storytelling. By integrating AI-driven characters, dynamic narratives, and personalized content into storytelling platforms, this research aims to explore how AI technologies can deepen emotional engagement, interaction, and connection within virtual environments. The study will examine how AI can provide real-time responses and adaptability, making the storytelling experience more fluid and personalized for users.

Another objective is to explore the role of AI in gamified digital storytelling, particularly in an educational context. This research will analyze how AI can be used to create interactive, learning-based narratives that adapt to the needs of individual users, providing real-time feedback and personalized learning experiences. The potential of AI to simulate historical events, cultural stories, or educational modules through game mechanics and storytelling will be critically assessed, highlighting its transformative role in education.

This thesis also aims to investigate the application of AI-driven storytelling in the field of game design and development. By incorporating AI into narrative design, this research will examine how AI can dynamically influence plot progression, character development, and player choices in games. The goal is to assess how AI characters and adaptive storylines can enhance player engagement, create replayable experiences, and offer deeper narrative complexity, especially within historically-based or culturally rich game settings.

1.2 Brief Description

The application developed as part of this thesis is a 3D game designed with a third-person perspective. Within the game's environment, users can explore specific areas of the terrain and interact with AI-driven characters placed throughout the landscape. These characters function as chatbots, with a prompt-based system guiding their behavior, personality traits, communication style, and willingness to share information. The adjustment and fine-tuning of these parameters form a core component of the research, as they contribute to evaluating the performance and adaptability of AI models in different scenarios.

Figure 1.1: Game Preview Visualization

A key focus of the application is to utilize varied prompting strategies for Non-Player Characters (NPCs) to enrich the user's experience and enhance the conversational content. By introducing a more realistic dialogue system, it becomes crucial to test multiple character variations to assess both the user's experience and the effectiveness of the information conveyed. This approach aims to examine how different NPC behaviors influence the overall engagement and depth of the interaction within the gaming environment.

In this framework, the user interface (UI) plays a crucial role in facilitating interaction between the player and the environment. The designed UI is essential for enhancing the user experience by providing intuitive navigation, clear communication of game mechanics, and smooth access to character interactions. The complexity of managing dynamic dialogues with AI-driven Non-Player Characters (NPCs) requires a UI that can present information in an organized and user-friendly manner, ensuring players can easily engage with the narrative elements without becoming overwhelmed. The overall effectiveness of the game's storytelling, immersion, and user engagement heavily depends on how effectively the UI integrates and displays these interactive elements, making it a critical aspect of the application's design and development.

The deliverable of this thesis is implemented in Unreal Engine 5, a game development platform that offers advanced features crucial for creating immersive and visually realistic environments. Unreal Engine 5 provides powerful tools such as Nanite virtualized geometry, which allows for high-quality, detailed 3D assets, and Lumen, a global illumination system that enhances the lighting realism. These features are particularly important for this implementation, as they enable the creation of a detailed, and as historically accurate as possible representation of the Gramvousa Island during the Greek War of Independence. Additionally, Unreal Engine 5's AI framework allows the integration of AI-driven characters, supporting complex behaviors and interactions necessary for the AI chatbots to function effectively.

The primary objective of this thesis is also to investigate the extent to which the integration of a tool, such as a GPT model, can enhance digital storytelling within a gaming environment. However, to effectively assess the model's capabilities, it is essential to introduce a challenging element— in this case, the historical context. Conveying historically accurate information presents a significant challenge, particularly in terms of how an AI model manages and facilitates conversation. The delicate balance between factual historical events and fictional or imaginative elements introduces a range of potential outcomes, each of which holds distinct value. Understanding how the AI navigates this balance is crucial to evaluating its effectiveness in storytelling.

The development of multidisciplinary applications like this one is highly significant, offering benefits across various fields. It is essential that technologies such as Artificial Intelligence are applied not only for technical and performance-driven purposes, but also in areas related to the humanities. Leveraging the capabilities of a GPT model in domains like digital storytelling broadens the impact of this technology, as it enables applications to engage with human emotions, interests, and personal experiences. Such integration highlights the potential of AI to shape narratives that resonate on a personal level, reminding us that, even in a digital world, the human element remains vital. Emotions and lived experiences are what define us, and initiatives like this ensure that the human aspect is never overlooked.

1.3 Structure of the Thesis

The structure of this thesis will be carefully described in the next chapters. The first chapter will explore the technology employed throughout the project and the research review carried out. After that, a detailed study of the results and their application will be analysed in depth.

The second chapter will present a thorough review of the existing state-of- the-art in digital storytelling applications, the function of artificial intelligence in game engines, and the usage of artificial intelligence both in the gaming sector and in the preservation and presentation of cultural heritage. An extensive literature review and an examination of relevant past studies done in these fields will be critically evaluated in this chapter.

Chapter 3 will address the technologies applied in the evolution of this project such as Unreal Engine, Blender, and Rhino, among others and also present the project's user experience, including examples of user cases to show its capabilities.

Deeper into the user experience system, Chapter 4 provides a thorough analysis of user interaction with the mechanics and environment navigation. This part will carefully review the user interface's design, thereby offering understanding of the design decisions.

With a focus on the technical elements of the project, Chapter 5 will provide a thorough review of the codes and libraries incorporated during the development stage. It will also showcase the several technologies used, set out their implementation as well as the modifications made and obstacles tackled during the project.

In conclusion, Chapter 6 offers a synopsis of the results from the field testing and user feedback of this thesis. It evaluates the outcomes and offers constructive conclusions regarding the importance, capabilities and effectiveness of the initiative. Stemmed by the results and comments covered, this chapter will also suggest future enhancements to the application.

Chapter 2

Research Overview

2.1 Introduction

The key concepts and technologies influencing modern cultural engagement —digital storytelling, digital heritage, gamification, and artificial intelligence (AI)—are systematically reviewed in this chapter. This literature review explores the significance and the convergence of these fields and their continuous transforming possibilities in education, entertainment, and cultural preservation. The chapter also examines the setting in which various technologies interact and underlines their utilisation in producing immersive and interactive experiences. The following sections explore the development and uses of digital storytelling, the digital means of cultural preservation of heritage, and the gamification and artificial intelligence integration to improve user involvement. This chapter lays a strong academic foundation on how these technologies are changing cultural narratives and heritage in the digital era by aggregating existing relevant research.

2.2 Importance and Relevance

The significance of digital storytelling, digital heritage, gamification, and AI has expanded dramatically in recent years. Digital storytelling, which merges traditional narratives with multimedia elements, fosters deeper engagement and personalization, making it a powerful tool in education, marketing, and entertainment , fosters deeper engagement and personalization, making it a powerful tool in education, marketing, and entertainment [1], [2]. Likewise, exhibiting and conserving cultural treasures depends much on digital legacy. Through the digitization of artifacts and the creation of virtual sites, it enhances accessibility and fosters meaningful connections with history [3], [4].

Gamification, the application of game-like mechanics in non-game contexts, further amplifies user interaction. By incorporating elements such as rewards, challenges, and progression systems, it enhances motivation and engagement in fields like education, marketing, and cultural heritage [5],[6].By allowing customised and adaptive experiences, artificial intelligence enhances these technologies. For instance, AI tailors digital storytelling and gamified content to individual preferences, creating more immersive and engaging interactions [7],[8]. Together, these technologies are reshaping cultural engagement,learning, and preservation.

2.3 Context

The convergence of digital storytelling, gamification, digital heritage, and artificial intelligence is changing user interaction with cultural material. Technologies like virtual and augmented reality (VR/AR) provide immersive experiences, enabling users to explore historical sites interactively [9],[10]. AI enhances these experiences by personalizing interactions based on user preferences [11].

When gamification is combined with these technologies, the results have exhibited greater involvement; from gamified museum exhibits to location-based heritage tours, these experiences motivate users to explore and learn in engaging ways [10]. The digital transformation of cultural heritage is not limited to preservation; it also promotes global accessibility, enhances learning, and fosters cultural understanding and appreciation [12].

2.4 Digital Storytelling: A New Narrative Paradigm

Digital storytelling transitions from passive consumption to active involvement. Digital storytelling is the merging of diverse multimedia elements, including text, audio, video, photos, and interactive media, into narrative frameworks. This combination creates an immersive and dynamic experience that surpasses traditional storytelling formats [1].The interactive nature of these narratives—leveraging multi-sensory engagement, where sound, visuals, and sometimes tactile feedback intensify emotional connections—creates personalized experiences, engaging audiences through diverse media formats that appeal to different learning styles and preferences, allowing users to see themselves within the narrative [13]. Digital storytelling's main benefit is its capacity to let the audience develop a closer emotional connection. By enabling active participation, it invites users to engage with the story in meaningful ways, making them an integral part of the narrative process [11]. According to research by Liu and colleagues [14], AI technologies such as natural language processing and machine learning are utilized to craft narratives tailored to individual preferences, further enhancing engagement and emotional connection. Initially simple, digital storytelling has evolved with technological advancements, incorporating video, animation, and interactivity to enhance engagement [15].

Its uses are many and cover cultural heritage, entertainment, and learning. Interactive stories, for example, enable readers to investigate fictitious worlds or historical events in original ways, therefore strengthening their emotional bond and personal perception of the materials. Additionally, the personalisation aspect in digital storytelling ensures that each participant's experience is unique, driven by their interactions, preferences, and choices, making it distinctly different from traditional linear storytelling [2].

Reflecting the several possibilities of this media, the applications of digital storytelling have multiplied recently. In **education**, digital storytelling has proven to be an effective pedagogical tool, as it allows students to create their own narratives, thereby enhancing their understanding and retention of subject matter [1]. Particularly when students are working on digital stories, the technique promotes critical thinking, creativity, and teamwork. In **entertainment**, digital storytelling powers interactive video games and online series, where users actively shape the plot through their decisions, enhancing user agency and immersion [11]. Additionally, **cultural heritage organizations** have embraced digital storytelling to engage audiences with historical narratives and cultural resources. By using digital platforms to present stories, museums, heritage sites, and galleries make cultural heritage more accessible and compelling, fostering deeper engagement with history [13].

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Digital storytelling presents great promise but is not without difficulties. Particularly in underdeveloped places, technological constraints include access to high-quality multimedia tools and the knowledge needed to produce such content can impede general acceptance. Furthermore, there is a need for a deeper understanding of how interactive elements can be designed to ensure they truly enhance the narrative experience rather than distract from it [11]. Integrating developing technologies like artificial intelligence and machine learning promises even more customized and adaptive narrative experiences as digital storytelling develops.

2.5 Digital Heritage: Preserving the Past for the Future

Digital heritage is the application of digital technologies for documentation, preservation, and distribution of cultural legacy. By transforming physical artifacts and heritage sites into digital formats, it safeguards cultural materials for future generations while democratizing access for global audiences [3]. This is particularly critical in an era where physical heritage faces threats from climate change, natural disasters, and human conflict [16].

The field emerged in the 1990s, initially focused on digitizing physical objects. However, the advent of immersive technologies like virtual reality (VR) and augmented reality (AR) revolutionized the sector, enabling interactive and immersive engagement with cultural content [12]. VR, for instance, VR, for instance, offers people the opportunity to visit historically important landscapes or ancient ruins that no longer exist, therefore transcending conventional museum exhibits.

Key technologies contributing to the successful operation of digital heritage include 3D modeling, visualization, AR, and VR. 3D modeling creates precise digital replicas of artifacts and sites, facilitating detailed analysis and preserving fragile or endangered materials [17]. AR enhances real-world environments by overlaying digital information, enriching heritage tours with contextual insights [10]. Meanwhile, digital archiving preserves vast amounts of historical data, making cultural content accessible to scholars and the public [4].

Digital heritage has transformative applications across multiple sectors. In cultural preservation, it documents and conserves artifacts while reconstructing sites at risk of deterioration or loss [3]. Digital reconstructions of historic sites like Petra, for example, let contemporary viewers visit these places as they were. Museums increasingly employ interactive displays, gamified experiences, and AR/VR applications to engage visitors more dynamically [18]. VR shows, for instance, let users experience artworks or historical events, thereby strengthening emotional connection as well as education. In tourism and education, AR-enabled tours and virtual heritage experiences provide personalized, real-time information, enriching visitor engagement [19]. AR overlays images of their historical look at monuments like the Roman Forum or the Pyramids of Egypt, therefore providing a closer knowledge of their cultural relevance.

Digital heritage also empowers communities to preserve and share intangible cultural heritage—such as oral traditions, music, and crafts—through digital media [9].For example, indigenous people protect oral traditions by means of digital archives and storytelling tools, therefore guaranteeing their passing on to next generations.

However, digital heritage also faces significant challenges. Issues such as data corruption, software obsolescence, and the fragility of digital formats threaten the long-term accessibility of digital heritage [12]. Additionally, the digital divide limits access to these technologies in underserved regions, raising concerns about equity and inclusivity [14]. To address these challenges, ongoing investment in infrastructure, training, and international collaboration is essential [16].

2.6 Gamification: Engaging Through Play

Gamification refers to the application of game design elements—such as points, rewards, challenges, levels, and badges—in non-game contexts to motivate and engage users [5]. Gamification turns daily tasks into more dynamic and fun experiences by including these mechanisms into settings including education, business, and cultural heritage. This strategy uses the inherent attractiveness of games to promote social connection, accomplishment, and progress—encouragement of participation in ways that conventional approaches sometimes fall short.

The effectiveness of gamification is rooted in motivational theories. Self-determination theory [20] highlights the importance of balancing intrinsic motivation (driven by personal satisfaction) and extrinsic motivation (driven by external rewards). Although extrinsic rewards might draw consumers and preserve their initial attention, intrinsic motivation guarantees long-term involvement. To maximize user involvement, gamification deliberately combines both kinds of motivation. Additionally, Bartle's [21] player typology—which categorizes users as achievers, explorers, socializers, or killers—underscores the need for personalized gamified experiences. Deeper involvement and more general appeal depend on game mechanisms being tailored to fit user tastes.

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Creating successful gamified systems calls for thorough study of concepts and techniques. Feedback loops, for instance, are critical for maintaining higher levels of engagement by providing immediate rewards or challenges that keep users motivated [6]. By providing clear objectives and concrete rewards, achievement systems and reward mechanisms pique even more curiosity. These components build a disciplined, goal-oriented environment that motivates ongoing involvement and fosters a feeling of development. Gamification's adaptability and influence have helped it to be embraced extensively in many different fields. In terms of cultural heritage, gamified components have been included into museums and heritage sites to improve tourist involvement. Interactive exhibits, scavenger hunts, and educational games immerse visitors in cultural narratives, promoting a deeper understanding of history and heritage [10]. In travel, location-based gamification has also become popular with apps pushing users to investigate locations and expose secret facets of cultural institutions. For example, apps that reward users with points or virtual badges for visiting landmarks, not only enhance the tourist experience but also add educational value [19].

Gamification has shown promising potential in marketing and business in increasing employee and customer involvement. Loyalty programs, for instance, use points, discounts, and tier based rewards to incentivize consumer behavior, fostering long-term brand relationships [6]. Similarly, gamified employee training programs leverage simulations and performance tracking to motivate workers, improving skill acquisition and task completion [22]. These applications show how gamification may match user drive with organizational objectives to produce mutually beneficial results.

Gamification has also been embraced by the wellness and health industries to encourage behavior modification. To inspire physical exercise, fitness apps as Fitbit and Strava make use of progress tracking, social rewards, and competitiveness. By providing real-time feedback and achievement milestones, these platforms cultivate a sense of accomplishment, which enhances user motivation and adherence to fitness goals [22]. Long-term behavioral improvements have been demonstrated by the gradual character of gamified health interventions together with social and community-driven features.

Despite its widespread adoption, gamification is not without challenges. Over-reliance on extrinsic rewards can undermine intrinsic motivation, leading to short-term engagement rather than sustained participation [20]. Furthermore, badly crafted gamified systems could not appeal to different user groups, which emphasizes the crucial need of understanding and constantly researching the ever evolving user preferences and motivations. Gamification has to be carefully applied to maximize its possibilities by balancing game elements with relevant, context-specific goals.

All things considered, gamification is a great instrument for improving learning, motivation, and involvement in many spheres. It turns everyday activities into more exciting events by linking entertainment with utility, therefore encouraging participation and closer relationships. Gamification promises great potential to solve difficult problems in education, business, health, and cultural legacy as its uses keep growing.

2.7 Artificial Intelligence in Digital Storytelling and Gamification

In digital storytelling and gamification, artificial intelligence (AI) has become a transformative force having a major influence in how stories are produced, experienced, and personalized. Leveraging cutting-edge technologies such Natural Language Processing (NLP), Machine Learning (ML), and Computer Vision, AI enables dynamic, adaptable, and immersive experiences that fit to personal user preferences and behaviors. From cultural heritage to entertainment and education, these skills not only improve involvement but also create fresh opportunities for creation and interaction across many fields.

The Role of AI Technologies in Enhancing Storytelling and Gamification

Three fundamental technologies—NLP, ML, and Computer Vision—lie at the core of AI's influence on gamification and narrative. NLP lets artificial intelligence systems create human-like language, therefore facilitating fluid and contextually appropriate interactions between consumers and virtual characters or systems. For instance, in gamified environments, NLP can adapt dialogue based on player input, creating personalized narratives that evolve in response to user choices [23]. This ability is especially important in interactive storytelling since immersion depends on the capacity to sustain cohesive and interesting conversation.

ML analyses user behavior and preferences to dynamically adapt stories and games, therefore complementing NLP. By identifying patterns in user interactions, ML algorithms can adjust storylines, difficulty levels, or rewards in real time, ensuring that each experience feels unique and engaging [24]. Maintaining user interest depends on this adaptability since it promotes agency and helps to avoid predictability.

By allowing artificial intelligence systems to read and react to bodily gestures, facial emotions, or motions, computer vision improves immersion even more. In AR and VR environments, this technology allows users to interact with digital elements in intuitive ways, blurring the line between the virtual and real worlds [25]. A user visiting a virtual historical site, for instance, might utilize gestures to find hidden objects; the AI system reacts in real time to produce a flawless and seamless experience.

These technologies taken together allow artificial intelligence to produce highly customized and emotionally compelling experiences, hence strengthening user-story relationships. AI guarantees that tales and gameplay remain interesting and relevant to consumers by automating decision-making and constantly changing material.

Applications of AI in Digital Storytelling

AI finds extensive and diverse uses in digital storytelling across many fields. In terms of cultural heritage, immersive and instructive events powered by artificial intelligence are bringing history to life. For example, AI-guided tours and AR/VR reconstructions allow users to explore virtual recreations of historical sites, such as ancient cities or archaeological sites [26]. These encounters improve historical involvement as well as offer useful instruments for preservation and teaching, therefore allowing users to interact with cultural legacy in ways that were not possible a few years ago.

Within the entertainment sector, artificial intelligence is transforming interactive narrative in digital media including video games. Games like Detroit: Become Human demonstrate how AI can adapt storylines based on player choices, creating branching and alternate narratives that offer high replayability and emotional depth [6]. Likewise, by offering dynamic dialogue and narrative elements, AI-powered chatbots and non-player characters (NPCs) are enhancing gameplay. Chatbots such as Google's Bard, for example, can create NPC, dialogue, and narration, therefore producing more responsive and immersive gaming environments. These AI-driven characters can serve as quest givers, providing players with detailed information and context during key scenes, thereby enhancing the overall narrative experience[1].

AI-powered gamified systems are being applied in business and marketing to customize consumer interactions and increase involvement. By analysing customer preferences and behaviors, AI can tailor rewards, challenges, and feedback to individual users, creating more effective loyalty programs and training initiatives [27]. AI can create gamified training courses, for instance, which change to fit workers' learning styles and progress thereby enhancing skill development and retention.

AI as a Co-Creator in Storytelling: Opportunities and Challenges

Beyond mere automation, artificial intelligence plays a co-creator role helping human storytellers create and polish their works. Kasunic and Kaufman [28] categorize AI's contributions to storytelling into three areas: (1) teaching AI to generate and understand stories[29], (2) assisting human storytellers as co-creators, [30] and (3) modeling story elements [31]. Thanks to developments in NLP, generative art, and deep learning, artificial intelligence can now produce stories with ever more complexity and provide tools to simplify the creative process.

GPT models and other artificial intelligence systems, for instance, can create text, conversation, and even whole story arcs, therefore saving time and effort needed for content production. In sectors like gaming and marketing that call for quick narrative distribution and production, these instruments are very useful. However, the way that

[1]McCurdy, W. (2023) No more 'I took an arrow to the knee': could AI write super-intelligent video game characters?, The Guardian.

artificial intelligence is used in narrative making also raises ethical questions, especially with relation to prejudice, cultural sensitivity, and the possible loss of human ingenuity. AI-generated stories may inadvertently perpetuate biases related to race, gender, or nationality, as they rely on training data that may contain inherent prejudices [29]. This emphasizes how closely monitoring and curating must be done when utilizing artificial intelligence to produce stories.

Furthermore, even if artificial intelligence can help create stories, it still finds it difficult to create completely accurate and complex narratives with regard for culture. In scientific or cultural contexts, for example, the Acropolis Museum, AI-generated stories have to be carefully selected to prevent mistakes and contradictions. Current artificial intelligence systems limit their power to create accurate and significant narratives by not fully absorbing cultural knowledge and experiences.

The Future of AI in Storytelling and Gamification

By providing multimodal, immersive experiences that span conventional limits, the integration of artificial intelligence with AR and VR technologies is poised to transform narrative. These technologies improve the interaction and vividness of storytelling, therefore forging closer emotional ties for consumers. AI-powered AR applications, for instance, can overlay historical reconstructions onto actual surroundings so that users may visit ancient locations as they were. Likewise, VR experiences provide hitherto unheard-of degrees of immersion and interaction and can carry users to totally imaginary realms.

2.8 Challenges and Future Directions

Still, the direction of artificial intelligence in gamification and narrative depends on tackling important obstacles. Training data and algorithms must constantly evolve if artificial intelligence systems are to provide accurate and culturally relevant narratives. Furthermore, especially with regard to bias and the preservation of human creativity, the ethical consequences of AI-generated content have to be carefully examined.

Ultimately, artificial intelligence offers fresh opportunities for personalizing, interactivity, and immersion, thereby improving digital storytelling and gamification. AI has the ability to change how stories are produced and experienced by augmenting human creativity with cutting-edge technologies. Realizing this promise, though, will need careful attention to ethical issues and a dedication to maintaining the special character of human narrative.

Chapter 3

Technological Background and Project Structure

3.1 Introduction

It is crucial to initially lay a firm technological basis before going into detail about the general user experience and the particular execution of our application. We will start by outlining the various programs that were used, providing definitions for important technical terms, and emphasizing any particular features that were included, along with a thorough rundown of the project structure.

All things considered, this chapter acts as a technical manual and point of reference for comprehending the technological foundation of the application.

3.2 Blender 3D

From modeling and sculpting to animation, rendering, and visual effects, Blender 3D is an open-source, potent 3D production tool used for a broad spectrum of applications. It allows UV unwrapping, texturing, rigging, simulations, and video editing. Because of its adaptability and broad community support, blender is being employed in sectors including game creation, movie production, and 3D printing.

The heightmap of the gaming environment was created using Blender 3D specifically for this project. Commonly employed in terrain modeling for 3D environments, heightmaps are grayscale pictures whose brightness of each pixel relates to height data. Heightmaps can be created in Blender either imported or generated to produce detailed scenes. The process begins with applying the heightmap to a plane or mesh over a displacement modulator, where the grayscale values change the vertices to create a 3D surface. Changing contrast and resolution to regulate the terrain's complexity, adding noise or blending layers for more realistic looks, and aggregating several maps for intricate landscapes help to customize heightmaps. These heightmaps are therefore quite valuable in game creation, simulations, and visualizations since they can be fine-tuned with Blender's sculpting tools or shaders to reach the intended degree of realism.

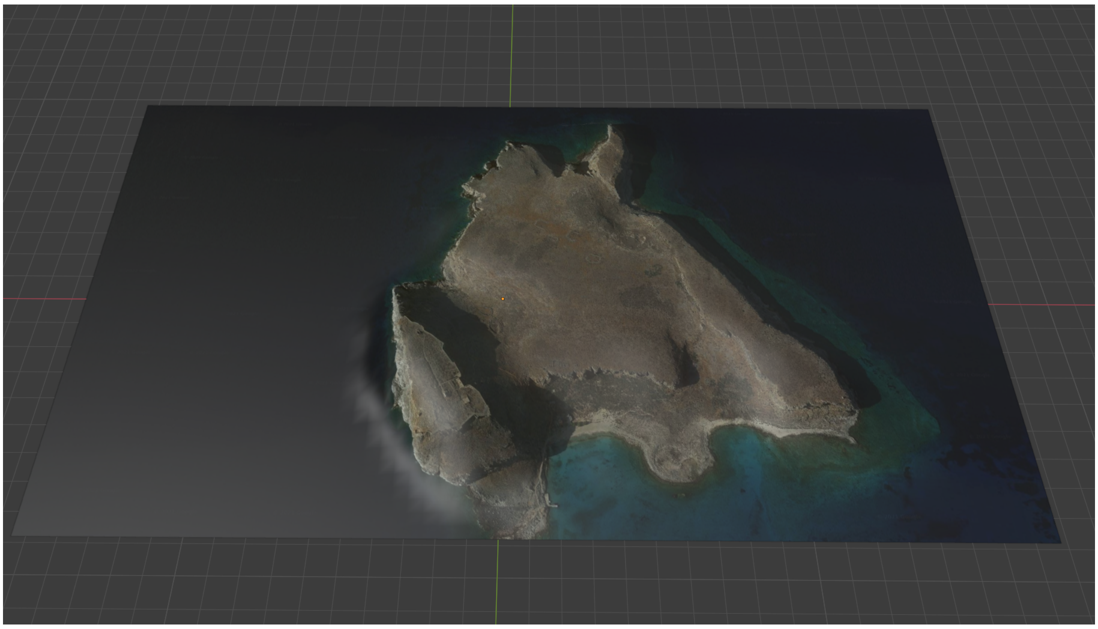

Figure 3.1: Map customization in Blender

3.3 Unreal Engine 5

The gaming engine selected for the project development was Unreal Engine 5. When choosing between Unreal Engine and Unity, the latter seemed more appropriate and appealing, especially since Unreal Engine 5 had just been made available at the time work started. Significant benefits are provided by its most recent version, particularly

Figure 3.2: Gramvousa Island heightmap

in the areas of landscape design, lighting implementation, and material interaction in a gaming context.

From an implementation standpoint, Unreal Engine's use of Blueprints—a visual scripting system—proved advantageous for those less familiar with traditional coding. Additionally, this functionality offers flexibility for future improvements, enabling developers to quickly add new features without requiring any programming knowledge.

3.3.1 Assets

In Unreal Engine 5, assets are defined as any unique piece of material utilized in the creation of a game or application. These can cover a broad spectrum of components including 3D models, textures, materials, audio, animations, and Blueprints—visual scripts. Assets are the building blocks of a project, each playing a distinct role in shaping the interactive, visual and audio components within the game environment. Unreal Engine 5 also brings cutting-edge capabilities for asset management and optimization, therefore facilitating the handling of big,complex and challenging projects.

3.3.2 Levels

Levels in Unreal Engine are self-contained settings or maps inside a game or application, separate areas where gameplay, assets, and interaction features are positioned. Every level can have distinct settings, including different terraces, lighting, and assets, therefore enabling different gameplay experiences all around the project.

Giving players access to important features such as launching the game, changing settings, or loading saved progress calls for a primary menu. It provides users' point of view to negotiate the game. The gaming scene is defined as the real level setting or surroundings in which the main gameplay takes place. A seamless and orderly player experience depends on the mix of a primary menu and gaming scenes, which helps to provide appropriate transitions between user interface (UI) components and gameplay locations.

3.3.3 Game-Objects

The fundamental components of Unreal Engine 5—that the player interacts with or modifies the environment—are known as game objects. These can be characters, objects, lighting, cameras, or even topographical elements. In Unreal, they are usually referred to as Actors.

3.3.4 Components

Comprising tiny building elements, components define an actor's appearance or behavior. They can influence things such as the form, materials, physics, or sound of an object. Actors have components added to them to extend their usefulness; such as adding a mesh component for visuals or a physics component for movement and collision detection.

3.3.5 Blueprints

Designed as Unreal Engine's visual scripting system, blueprints allow users to create gameplay mechanics and logic, without previous knowledge of coding. Users of blueprints can specify how Actors and Components interact or behave via a node-based interface, offering a very flexible and easily accessible technology that lets creators quickly develop intricate gameplay aspects.

3.4 Project Structure

The main systems of the application and their uses will now be examined. Every system's option shall be justified, therefore clarifying why these particular decisions were deemed suitable for the particular needs of the application. The chapter following will offer a thorough technical examination of their execution.

3.4.1 General Requirements

This thesis's main aim is to present a narrative via time-traveling experience. Given that users may not be able to physically visit the island where the events take place, the project presents a unique challenge. This emphasizes the need of meticulous design, especially with relation to terrain and environmental integration. Immersion in the experience and comfort of users as they explore the content depend critically on key elements such as the degree of detail in the terrain materials of the island and the quality of the 3D assets employed.

Apart from the design aspects, the program has to incorporate a navigation mechanism enabling exploration and interaction. To maximize the use of the map and its assets, a third-person perspective has been chosen, providing users with a more engaging and intuitive way to explore the environment. In gaming contexts, third-person view gives players a perspective from which to observe their character either behind or somewhat above, thus letting one see more broadly, compared to first-person view, which facilitates map exploration and navigation. Especially in open-world or exploration-oriented games, it has various benefits since players may better evaluate their surroundings, locate far-off items, and evade challenges. Third-person perspective also improves spatial awareness, which makes it perfect for platforming, combat, and exploration since players may simultaneously see their character and the surroundings, therefore producing a more immersive and strategic experience.

This project's target audience is varied, hence the gameplay techniques and navigation had to be kept simple. This ensures that users concentrate on the storytelling experience without encountering difficulties in navigating or using the application. Maintaining user involvement and ensuring that the experience is accessible to everyone depend on simple design.

Additional functional requirements for the overall system are detailed below:

- The application must feature a user-friendly, minimalist interface, ensuring ease of use for all audiences.
- The system should deliver immersive 3D visualizations of the island of Gramvousa, while clearly distinguishing between assets and interactive objects or actors.
- The application should provide clear instructions and guidance, helping users navigate and utilize its features effectively.
- Redundant information should be avoided, ensuring a streamlined and concise user experience.
- Internet connectivity is required for the application to fetch and display real-time conversations with the OpenAI API.
- The application should be designed with scalability in mind, allowing for future upgrades and enhancements to expand its capabilities.

3.5 Coding Structure

Leading platform for game creation, Unreal Engine 5 (UE5) boasts a strong toolkit meant to produce dynamic and immersive experiences. UE5's Blueprint Visual Scripting System, which allows creators to develop gameplay mechanics, events, and systems without in-depth knowledge of conventional text-based programming languages like C++, is a noteworthy quality. This section explores the technical features of UE5's Blueprint system, including its use in producing interactive graphics, AI-driven interactions, and its part in enabling non-programmers—including designers, teachers, and content creators—to enter game development.

3.5.1 Core Concepts of Blueprints

By abstracting the underlying C++ code, blueprints—a node-based visual scripting system—simplifies game creation. This technology allows ambient triggers, non-player character (NPC) behaviors, and fast prototyping of interactive pieces. There are numerous main components to blueprints, each with a different function in the process of development:

Blueprint Classes: These are built upon existing C++ classes such as Actor, Pawn, and Character. They allow developers to create complex entities, such as NPCs that can interact dynamically with players. For instance, a Blueprint Class can define an NPC's movement, dialogue systems, and responses to player actions.

Level Blueprints: These are scripts specific to individual game levels, controlling logic unique to that level. For example, a Level Blueprint can trigger events when a player enters a specific area, interacts with an object, or completes a task. This enables highly customized and context-sensitive gameplay.

Function libraries These include reusable logic blocks meant to ease the integration of intricate systems and interactions. By reducing unnecessary code and simplifying the application of shared features, Function Libraries improve efficiency.

Blueprint Interfaces: By means of pre-defined contracts, these enable communication between Blueprints, therefore guaranteeing freedom in developing environmental mechanics and artificial intelligence-powered interactions. A Blueprint Interface can, for instance, guarantee consistency across the game by standardizing how various NPC react to user inputs.

3.5.2 The Coding Architecture of Blueprints

Built on a modular and disciplined framework meant to streamline the development of interactive simulations and game mechanisms, UE5's Blueprint system There are several main components to this architecture:

Blueprint Graphs: These node-based scripting interfaces define events-driven interactions and logical flows. Every node stands for a function, event, or variable; connections among them control the execution flow. Based on user input, a Blueprint Graph might, for instance, set game states, activate animations, or govern environmental changes.

Blueprint Compiler:For real-time simulations, this element converts visual scripts into executable bytecode so as to ensure effective runtime performance. Blueprint Graphs' defined logic is optimized by the compiler, which qualifies them for demanding and complicated applications with respect to performance.

Data-Driven Design: Using a data-driven approach, blueprints let creators change game variables, artificial intelligence behaviors, and adaptive settings without changing the central logic. For iterative development in particular, this adaptability helps to enable fast prototyping and testing of fresh concepts.

Integration Layer: Over C++, blueprints offer an abstraction layer allowing developers and non-programmers to alter interactive parts without knowledge of coding. Programmers can still use advanced features as needed to guarantee that Blueprints remain a flexible tool for both new and experienced developers.

3.5.3 Blueprint-Based Coding for AI-Driven Interactions

Node-Based Programming Approach.

Using a node-based programming model, blueprints define logic by means of linked nodes that represent functions, events, and variables. This method maintains modularity and reusability in simulations and game systems while encouraging quick creation. By encapsulating logic into a custom node, a developer may, for instance, design a reusable AI behavior module.

Execution Flow Control: Branch, Sequence, and For Each Loop, among other blueprint execution nodes, establish logical operations depending on human input or AI-driven dynamics. These nodes let programmers build iterative procedures and sophisticated decision-making systems. A Branch node can, for example, assess a condition, such as player health, and execute several alternate logical paths depending on the outcome.

Event-Driven Interactions: Events act as stimuli for environmental changes, animations, or artificial intelligence reactions. The OnActorBeginning Overlap event, for instance, can start a planned sequence when a player reaches a designated area. This reinforces the notion that event-driven architecture makes gaming possibilities and user experience more dynamic and responsive.

Custom Functions and Macros: By encapsulating logic inside custom functions and macros, modularity is improved and artificial intelligence behaviors and game elements can be re-utilized in several settings. Custom functions for NPC discourse, for instance, might be utilized in several tiers to guarantee consistency and shorten development time.

Integrating AI with Blueprints

AI-driven interactions in Blueprints require dynamic responses based on player actions. Key integration strategies include:

1. Natural Language Processing (NLP): Links to external APIs to generate and process human-like conversation. An artificial intelligence system can use natural lan-

guage processing, for instance, to understand player input and create contextually relevant responses.

2. Behavior Trees: Help to manage artificial intelligence decision-making. Behavior Trees let creators specify intricate AI behaviours including environmental interaction, combat, and patrolling as well as fighting.

3. Event Dispatchers: Help to provide real-time communication between user interactions and artificial intelligence systems. Asynchronous responses made possible by event dispatchers help to guarantee that AI actions remain dynamic and context-sensitive.

For example, a Blueprint-based AI system can handle player queries and generate dynamic responses through the following workflow:
- Event Trigger: Player initiates an interaction.
- AI API Call: The system queries an external NLP API.
- Response Parsing: The AI processes the API response.
- UI Display: The system presents the response to the player via the user interface.

3.5.4 Accessibility for Non-Developers

Blueprints in UE5 include, among their most important benefits **accessibility to non-developers**, for example designers, teachers, and content creators. The node-based visual scripting system allows people without programming knowledge to automatically carry out complex interactions and mechanics. Blueprints let users define behaviors, control variables, and build interactive elements without coding, by presenting a graphical depiction of logic.

Furthermore, **exposed variables** enable developers to quickly adjust factors including animation attributes, artificial intelligence behavior settings, and event triggers. Reusable components and preconfigured Blueprint templates help to further simplify the development process, therefore allowing non-developers to create interactive experiences quickly and efficiently. Tools for real-time debugging and error feedback guarantee users' fast identification and resolution of problems, therefore improving the whole development experience. By encouraging cooperation between technical developers and non-technical experts, this accessibility helps to close the distance between creative design and technological execution. Blueprints thus enable a larger spectrum of users to design dynamic and interesting interactive applications.

Chapter 4

Use Cases and Experience

4.1 Introduction

In this section, the main use cases and user personas of the program are assessed, therefore offering a comprehensive overview of the normal user experience. It also aids in understanding the main UI elements and their purposes. The two primary user groups—that of the **player** and the **NPC**—take front stage.

After that, a thorough analysis of every screen in the program, that users can interact with, will be provided, highlighting the particular features they present. Customized based on the user type, the capabilities and access to UI elements guarantee different experiences according to their purposes.

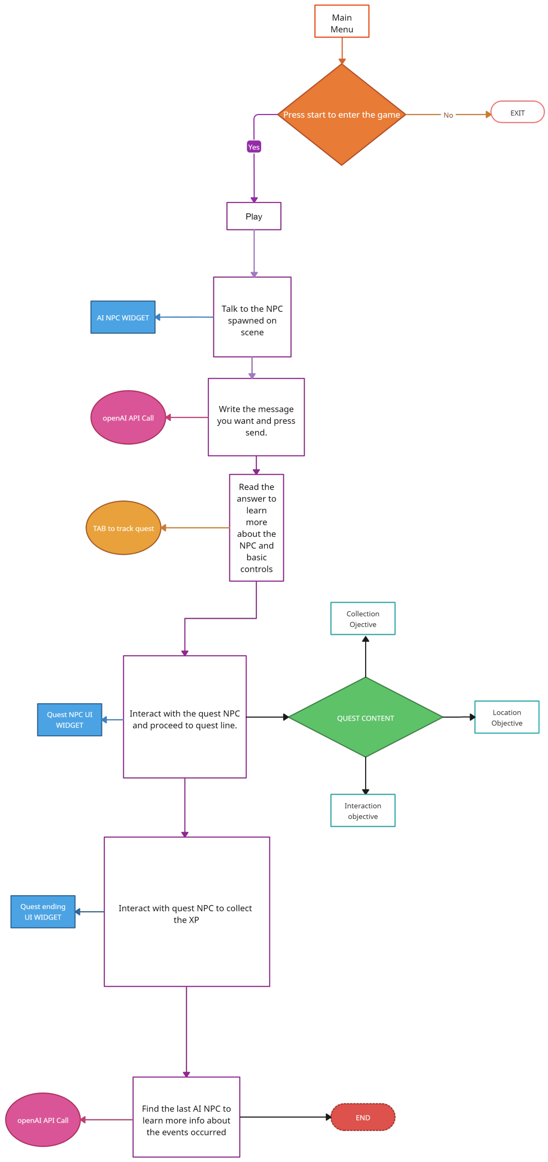

Figure 4.1: UI Flowchart

4.2 Startup Screen

When the application is launched, the user is presented with a starting screen with two main options: either **EXIT** the application or **PLAY** the game. To give a sneak peek of what to expect, the background is carefully selected from an in-game frame. The starting screen maintains a straightforward and user-friendly style in accordance with standard game design principles, giving users a chance to get ready for the next gaming session.

Figure 4.2: Initial Startup Screen

- **Play Option**

  Selecting the Play button initiates a sequence that triggers a cinematic transition, seamlessly shifting the camera to the point where gameplay begins. This mechanic is designed to ensure a smooth and immersive transition from the 2D Main Menu interface to the third-person gameplay perspective.

- **Exit Option**

  By selecting this option, the user can exit the application directly without entering the gaming environment. For user convenience, the exit functionality is also accessible within the in-game menu.

4.3 In-Game Use Cases and UI

4.3.1 Pause Menu

Upon entering the gaming environment, the Pause Menu UI widget is available to the user. The trigger enable point is the ESC button. This Menu provides the user with four different choices:

Figure 4.3: Pause Menu UI Widget

- **Resume**
  Allows the user to close the Pause Menu and return to gameplay mode.

- **Respawn**
  Returns the player to the starting location after the cinematic intro. It is an essential utility in case the player is stuck anywhere in the map and can't continue the gameplay.

- **Controls**
  A pop-up widget is spawn upon clicking this option with all the controls the user needs to navigate and interact with the environment.

- **Exit**

As mentioned before the exit the application option is also available in the Pause Menu.

4.3.2 Quest NPC Interaction Screen

The subsequent screen appears following the user's interaction (”E” button) with a quest-type NPC within the game. This screen presents all relevant information regarding the mission, including objectives and details. The user is then provided with two options: accept or decline the quest.

Figure 4.4: Quest Information Screen

After clicking the ”Accept” button, the player can read the quest information again but also track the quest progress. With the ”Decline” button the user can return to exploration mode.

4.3.3 Track Quest Screen

In order to improve user experience, it is crucial to be able to facilitate constant monitoring and tracking progress during the games. By pressing the "TAB" key, a widget screen opens that shows comprehensive information about the current quest status, including completed objectives and upcoming tasks. Selecting the "Track" button on the left side of the screen, near the current quest name, allows players to monitor quest progress in real time. By means of continuous progress updates and without forcing the user to hit the "TAB" key repeatedly, this live-updating overlay improves user convenience.

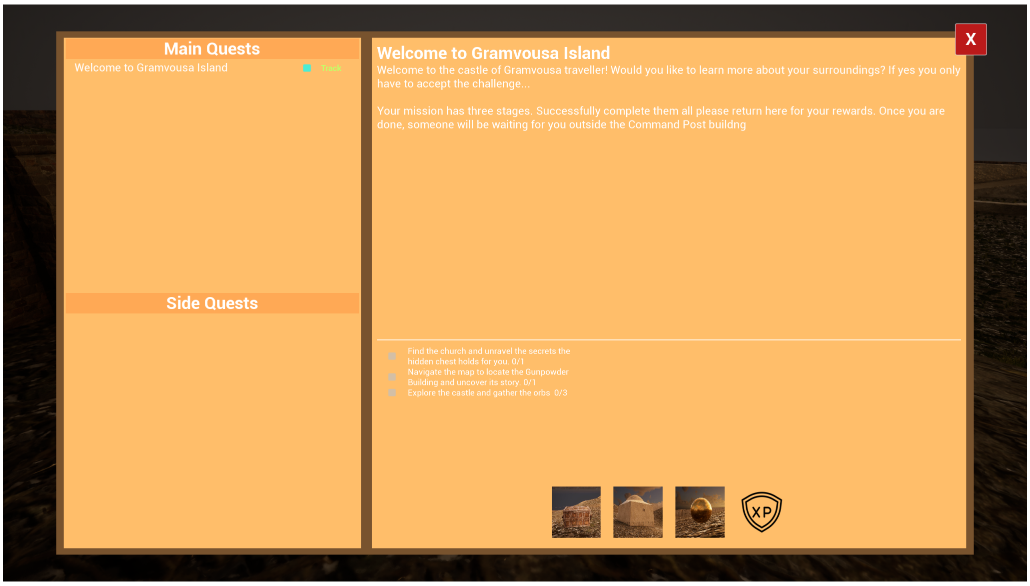

Figure 4.5: Track Quest Screen

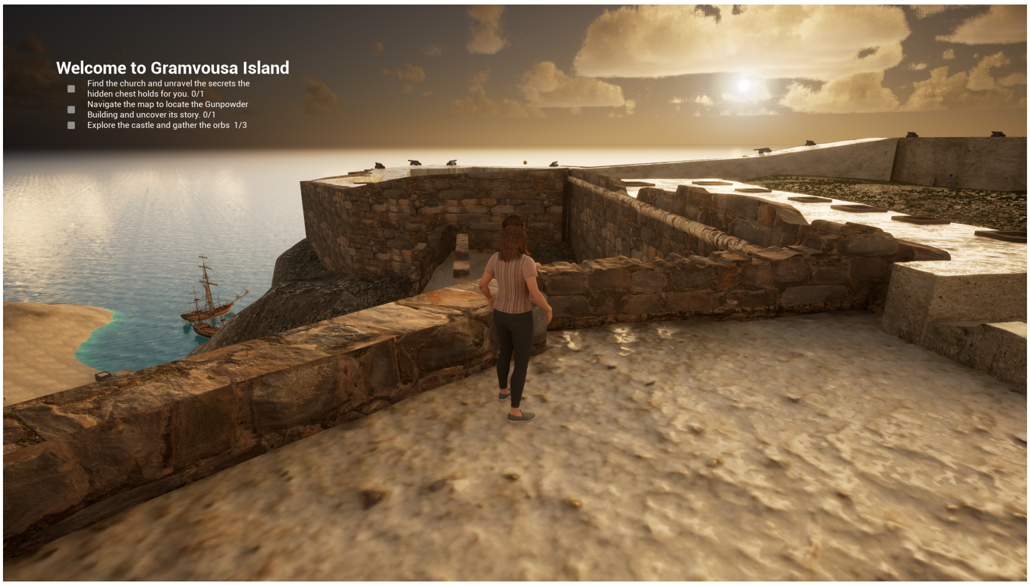

Figure 4.6: Live Tracking Overlay

Figure 4.7: Quest Objective Completion UI

4.3.4 AI-driven NPC UI

In this subsection of the thesis, detailed information will be provided about the User Interaction system, specifically regarding two distinct NPC interaction modes: an assistant-type NPC, which offers direct, task-oriented support, and a guide-type NPC, which provides more elaborate responses enriched with contextual information. Both interaction modes are accessible through a dedicated UI widget, ensuring a structured and user-friendly experience.

Figure 4.8: Talk indicator

4.3.4.1 NPC Assistant UI

The first type, the NPC assistant, serves as a responsive entity offering concise and goal-oriented interactions. Players can activate the dialogue system by pressing the T key, which opens the corresponding UI widget. Within this interface, the user can input messages in a text field and submit them via the Enter key or the Send button. The NPC's response is displayed in the far-right corner of the screen, providing immediate feedback. This assistant-type NPC is designed to answer straightforward queries, such as providing directions, offering inventory information, or explaining game mechanics. The interaction remains efficient, ensuring minimal disruption to the gameplay flow. Players can resend messages to clarify their requests or end the conversation at any time by selecting the Exit option, seamlessly returning to the exploration mode.

Figure 4.9: NPC Assistant UI

4.3.4.2 NPC Guide UI

The second type, the guide NPC, expands upon the assistant's functionality by delivering more detailed and narrative-driven interactions. In the same manner, pressing **T** key allows the user to view this NPC UI, type messages, and submit them using Enter or Send. The guide NPC, in contrast to the helper, provides more thorough explanations, lore, or character backstories, as well as historical background and storytelling. In order to produce an immersive and captivating experience, the dialogue system accommodates dynamic responses that adjust to the player's questions. This mode allows AI-generated narratives to improve world-building, which is especially helpful in settings where historical accuracy and cultural context are important. Players have complete control over their exploration and can leave the chat at any time, just as with the helper.

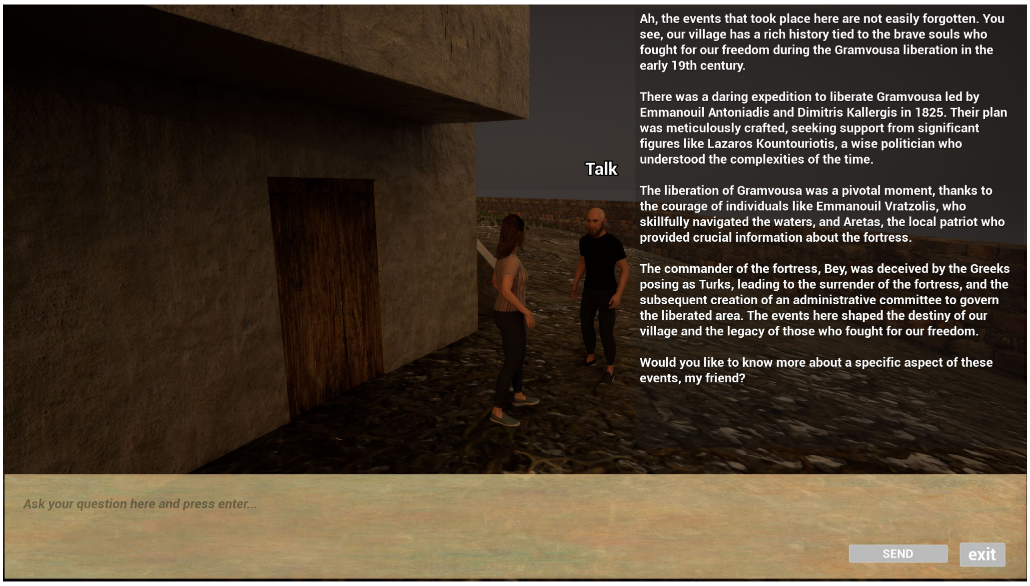

Figure 4.10: NPC Guide UI

Chapter 5

Implementation

5.1 Introduction

This chapter examines the implementation process, focusing on the technical procedures, the difficulties faced and the strategies used to overcome them. The environment, the application's graphical user interface, and the included technical components make up the three main parts of the implementation.

The coding, technological processes used, and the creation and integration of every component, including the graphical environment, 3D objects, and gameplay mechanics, are all covered in detail in the parts that follow.

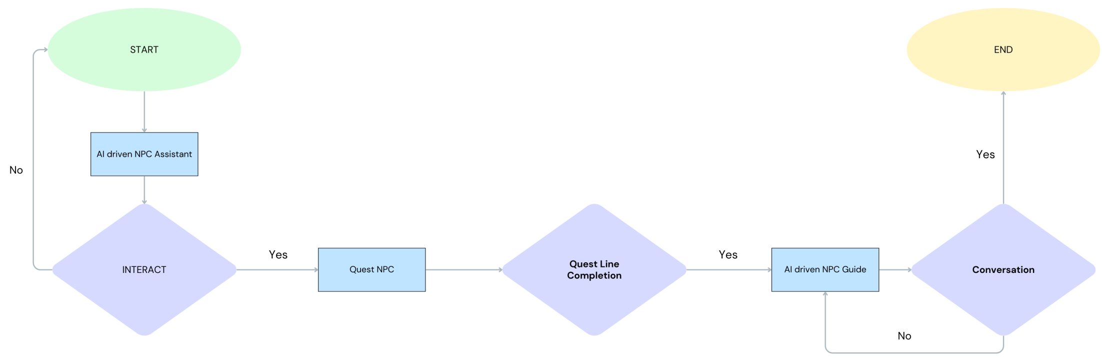

Figure 5.1: Gameplay Top Level Structure

5.2 Unreal Engine Scene Structure

There are several main components to the graphical scene, in which the whole application takes place. These comprise elements for lighting, sky depiction, natural elements, and meteorological events experienced during gameplay. For these features, a more aesthetically pleasant and realistic experience was produced using built-in Unreal Engine capabilities and extra plugins.

Combining these instruments means including them within the graphical environment and tweaking their features to produce particular effects. Lighting, together with sky components, clouds, and weather effects, can be changed to match and mirror various situations. Temporal setups, destined for adjusting these parameters, allow designers to generate climate features that complement the intended scene, thus enabling customizing choices.

Through user experience, it is possible to implement a temporal framework to enable dynamic changes in lighting and we ather conditions. Consequently, dynamic behavior guarantees a diverse and engaging experience from the end result. This flexibility highlights the work put into the graphical environment by keeping user attention on the contents of the game as well as the surroundings.

The dynamic change of these values also influences the impression of objects and characters within the scene. For 3D objects and characters, for instance, differences in lighting and weather conditions change their appearance. Object perception is strongly influenced by changes in light direction and intensity. For example, darker surroundings produce shadows and present a different impression than a sunny scene, which creates and highlight more refined details. Emphasizing several facets of the graphical environment helps the user to be more involved.

A comprehensive depiction of the scene composition is provided in the figure below.

Effective development, teamwork, and scalability in an Unreal Engine project depend on the organization of the scene structure. It guarantees methodical arrangement of all assets, game objects, and hierarchies so that things may be found, changed, and controlled more easily during development. A well-organized scenario helps to avoid uncertainty and the possibility of mistakes, like misplaced things or contradictory settings, therefore upsetting the workflow.

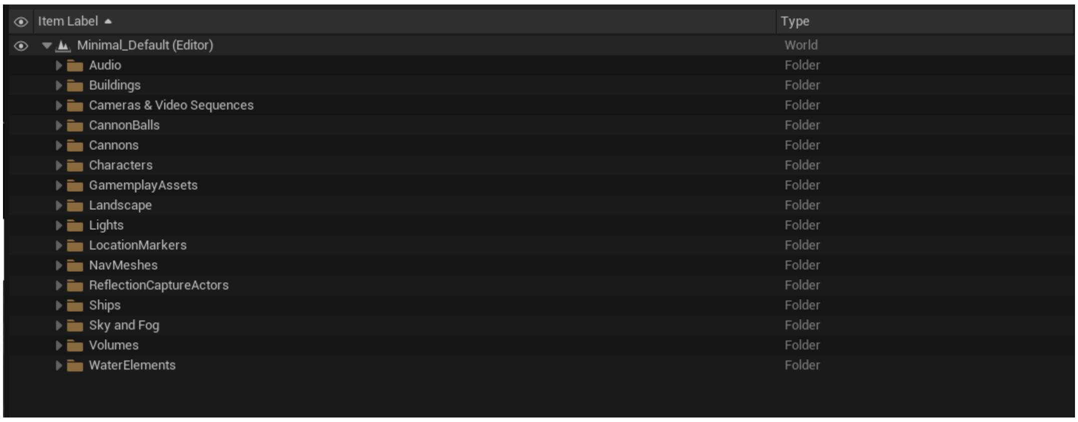

Figure 5.2: Unreal Engine Scene Structure

Below is a list of the game objects within the scene, accompanied by their respective purposes:

1. Audio:
   Inspired by the Cretan Renaissance, this folder features ambient noise mixed with music, used in the sound design. Their combined artistic harmony accentuates the graphic surroundings.

2. Buildings:
   Every 3D building seen in the scene is found in this folder. The models are arranged as 3D meshes so that their surface materials, textures, and scale may be readily changed.

3. Cameras & Video Sequences:
   Cameras and video sequences are great tools in Unreal Engine, for generating cinematic events that enhance the player's experience. Precision framing, movement, and depth made possible by cameras, help to professionally, film-likely bring situations to life. Conversely, pre-generated or scripted cinematic material is created using video sequences. A video sequence can be a gripping beginning, establishing the tone, mood, and setting for the story in a gameplay experience. From the start, this cinematic introduction fully immerses the player by deftly combining gameplay components with visual narrative.

4. Cannons and artillery balls:
   Used as decorative pieces in the graphical environment, these folders contain the 3D assets for the cannons and their ammunition. These are basic meshes with tailored materials and textures, and they are arranged apart from gaming assets, since they lack dynamic capability or user engagement. Their sole goal is to improve the scene's visual attractiveness and ambiance.

5. Characters:
   This section of the scene framework comprises all the various forms of character elements applied in the thesis. Three kind of characters are used. The player-activated character comes first. The second is the quest character, who interacts with the player and reports on the development of the search. Finally, there are two different artificial intelligence characters: one is an assistant and the other concentrates on offering informational materials. Every character interacts with the user using the UI design covered in the previous chapter.

6. Gameplay Assets:
   Three kinds of interactive objects are included in this folder. The first category comprises dynamically created cubes that help the user gather the collected orbs. The orbs themselves fall into the second category; they spawn in three separate sites to inspire the user to explore the designed surroundings. Finally, the final category consists of a dynamically produced treasure chest hidden within a building. Separate parts of the thesis will present thorough explanations of the mechanics underlying every interaction.

7. Location Markers:
   Game object components placed in the scene but not visible to the user make the location markers. They are just invisible cubes that can be used in collisions. Their UI interaction starts when a user's collision box crosses that of a marker. A UI widget showing pertinent information about the location shows on-screen as the user enters the assigned area. These location markers are used both for basic interactions and as part of the quest system, where specific markers trigger quest completion through the same collision event.

8. Lights:
   The light sources utilized throughout the environment are found in this section.

Unreal Engine's capabilities are used to create a photorealistic impression by mixing dynamic lighting with stationary lights. Integration of the "Sky and Fog" element is notably depended on dynamic lighting to provide best operation and visual consistency.

9. Sky and Fog:
This folder contains the "Volumetric Sky" feature of Unreal Engine. The volumetric sky, in combination with the Lights system mentioned before, is a powerful feature that simulates realistic atmospheric conditions by dynamically rendering volumetric clouds, fog, and lighting effects. It leverages advanced algorithms to create physically accurate skies, including real-time interactions with the sun and moon, volumetric scattering, and customisable weather patterns. This implementation enhances visual fidelity by adding depth, softness, and dynamic lighting transitions to the sky, allowing developers to create immersive environments with a natural look and feel. The flexibility of the volumetric sky system also makes it suitable for various artistic and gameplay scenarios, from clear blue skies to stormy, overcast atmospheres.

10. Water Elements:
This folder holds all the water elements used in the environment. The sea is created using Unreal Engine's "Water Body Ocean" feature, while the other water elements are simple water textures applied to cubes as materials. Placing these water material cubes inside the water tanks at the top of the fortifications gives users a realistic glimpse into how the fort used to stored water during its inhabited era.

The implementation of the most significant components will be further analysed in detail in the following parts of this chapter.

Figure 5.3: 3D scene Objects and Water elements

5.3 3D Objects - From creation to adaptation

An integral part of the scene involves the inclusion of 3D objects. These objects were sourced or created through three distinct methods:

1. Scanned 3D Objects:
   The first category includes 3D objects, scanned using drones, originally developed as part of a previous architectural thesis on the island of Gramvousa by Swtiris Ntzoufras [1]. These scanned models were transferred from the Rhino environment to Unreal Engine, where materials were applied for integration into the game's environment. Key objects include structures present on the island, such as fortifications on the triangular hilltop,the Church of "Panagia Kleftra", and the ammunition depot. These historical features remain on the island today and contribute to the realistic representation of the setting.

[1]Ntzoufras, S. (2017) "Robotics in Architecture μια νέα σχέση πραγματικού - ψηφιακού". Ρομποτικές εφαρμογές στην αρχιτεκτονική κατασκευή και σχεδιασμό. Η εφαρμογή WorldCraft (Swarm Fabrication app.) στη νήσο ήμερη Γραμβούσα.

2. Newly Created 3D Objects:
   The second category involves the creation of new 3D models in the Rhino environment. These models were designed to represent significant buildings as historically accurate as possible, enriching the scene with structures that played a pivotal role during the historical events of 1821–1825. Examples include the governor's residence, the school building, and port facilities, all of which provide important historical context. The addition of these buildings enhances the technical completeness of the scene and allows users to explore additional information through dialogues and interactions, bridging the gap between virtual space and historical content.

3. Unreal Engine Asset Library:

   The third source is Unreal Engine's asset library, which provides a variety of 3D objects such as vegetation and decorative elements. These assets were utilized to simulate a natural environment by placing plants and foliage on the terrain, enhancing the scene's realism. Additional elements, such as cannons, were included in the fortifications to better depict the historical setting of the era more accurately.

   Interactive 3D objects, including geometric shapes like boxes and spheres, were also incorporated to facilitate gameplay. These objects appear dynamically during the application, maintaining user interest by altering the environment as the game progresses.

5.3.1 Gamification

Gamification refers to the application of game design elements, such as points, badges, leaderboards, and **challenges**, in non-game contexts to motivate and engage users [32]. It uses psychological ideas of drive, incentive, and achievement to affect behavior and improve user experience in sectors such as business, education, and health.

Inspired by the aforementioned, it was determined in this thesis to present a gamification technique employing three kinds of interaction using the gameplay elements listed above.

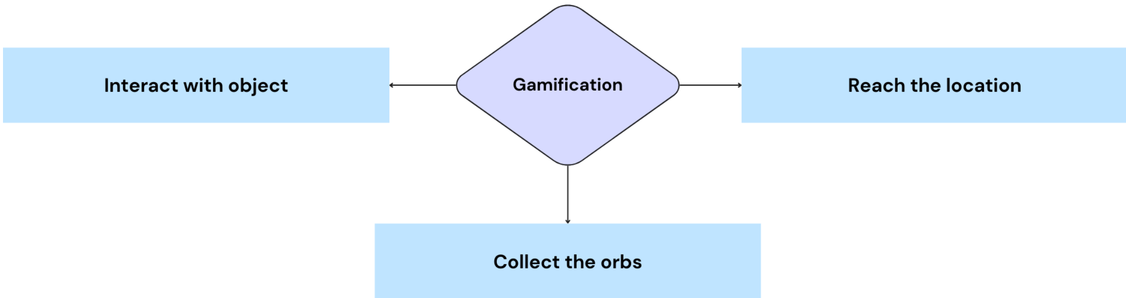

Figure 5.4: Gamification diagram

5.3.1.1 Object Interaction

Making an **interface Blueprint** that lets the player's character interact with a 3D asset, like an interactive chest, helps to enable communication between both. Through the interface, this arrangement lets the player easily interact with the chest, inducing bespoke actions like opening it or generating objects.

An interaction feature of an interface Blueprint defines a shared action that several objects can execute, such as **"Interact.**," in order to guide their behavior. Declared in the interface without any reasoning, this purpose functions as a contract. Blueprints that follow the interface, that is, a door, chest, or NPC, offer their particular reasoning for the "Interact" function—for example, opening the door, showing dialogue, or bestowing an item. Using the **Does Implement Interface()** node, the game determines whether the player interacts with an item which then implements the action on the interface. If such is the case, the object receives an "Interact" function that activates its particular behavior while preserving modular and decoupled communication.

In this case, the Quest log changes to indicate the job as completed after the interaction ends. The player cannot interact with the chest anymore, hence it is taken off the scene using the **Remove from Parent** feature.

5.3.1.2 Collection of the orbs

In video games, collectible objects are crucial for improving the player's experience, since they provide purpose for exploration and more depth to the storyline. From the user's point of view, the inclusion of collectibles maintains the interesting gameplay and stimulates curiosity as well as a sense of accomplishment if collected. Often used as a means of tracking development, they enable players to engage in meaningful interactions with the surroundings, therefore motivating them to keep exploring the surroundings.

Simple golden spheres are utilized in this thesis to show the collecting mechanic. These orbs are positioned in three different locations across the fort. Every orb contains a spherical collision component to facilitate interaction triggering an event when the user overlaps with it.

The orbs first go unseen to the player, unless the quest is accepted. The **SpawnActorFromClass()** node generates the orbs at their destined positions whenever the search is triggered through the UI. One of the sites features a set of 3D platforms to add an compelling element to the experience. To get the orb, players have to leap across several platforms, therefore providing a dynamic and riveting challenge for the interaction.

Figure 5.5: Collecting the orbs

5.3.1.3 Location Markers

Location markers play the last component of the gamification strategy. These markers are plain cubes appearing as transparent, so the user cannot see them. They do, however, feature a box collision and when the user overlaps them, a UI widget event is triggered.The **CreateWidget()** node is activated and shows an overlay message on the screen that indicates the position that the player recently entered. Although this implementation is simple, it provides a compelling degree of discovery as players hunt the sites indicated in the quest description, therefore generating a sense of success when they find them.

5.4 Characters

Examining the different kinds of character used in this thesis is the main emphasis of this chapter and it is essential to be clear about the differences between the player character and non-player characters (NPCs.). The NPC are part of the graphical world but run apart from user control, while the playable character reflects the player and is entirely under their control. The fundamental mechanics of both different character types and their functions in augmenting the general gaming flow will be discussed in the following parts.

5.4.1 Appearance

Since it is one of the first things players observe, the appearance of characters influences the gameplay experience greatly. This thesis identifies as the perfect answer the integration of the **MetaHumans** method. MetaHumans in Unreal Engine has excellent rigging and animation capabilities, therefore providing a strong basis for producing photorealistic artificial humans.

MetaHuman assets' integration was initiated with the selection of base models made inside Unreal Engine utilizing the official **Qupixel Bridge** plugin. Post-editing the default models was required to guarantee fit with the graphical environment of this thesis. Unreal Engine's online tool, the **MetaHuman Creator**, allows precise customization of any character, therefore enabling this. The choice and editing process comprised characters of different sexes and ages, therefore guaranteeing a wide representation within the project and preserving a high degree of variety.

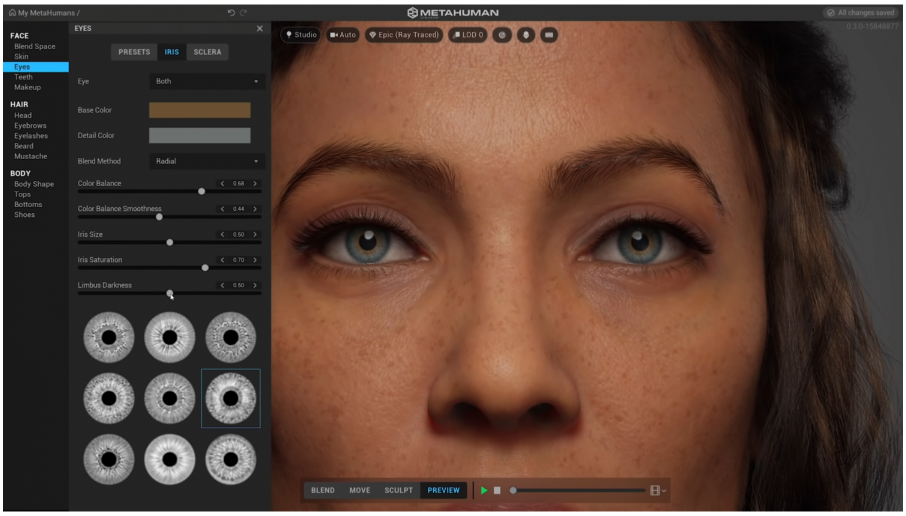

Figure 5.6: MetaHuman Creator Interface

5.4.2 Player Character

The application of the player character in Unreal Engine for this thesis is aimed at generating a third-person movement and behavior mechanism. Constructed with a skeletal mesh, an animation blueprint, and a character blueprint to describe movement and interaction, the player character is created using Unreal Engine's pre-configured **"Third Person Template"**

Supporting movements including walking, sprinting, jumping, and crouching, the **Character Movement Component()** offers the basis for third-person navigation. Connected to the **Add Movement Input()** node in order to apply directional movement depending on the player's input, key blueprint nodes include **InputAxis** nodes for processing player input, such as **"MoveForward"**, and **"MoveRight**.

The **InputAction()** nodes are responsible to manage the handling of specific interactions, such as jumping, activated by the **Jump** function. By means of the Add Controller Yaw Input and Add Controller Pitch Input nodes, camera behavior is under control, therefore enabling smooth rotation depending on mouse or controller input.

Furthermore, **Line Trace via Channel()** nodes use logic for interaction to identify things the player interacts with, therefore enabling gameplay mechanisms as item collecting or triggering events. This modular design guarantees extensibility and seamless fit into the general gaming flow.

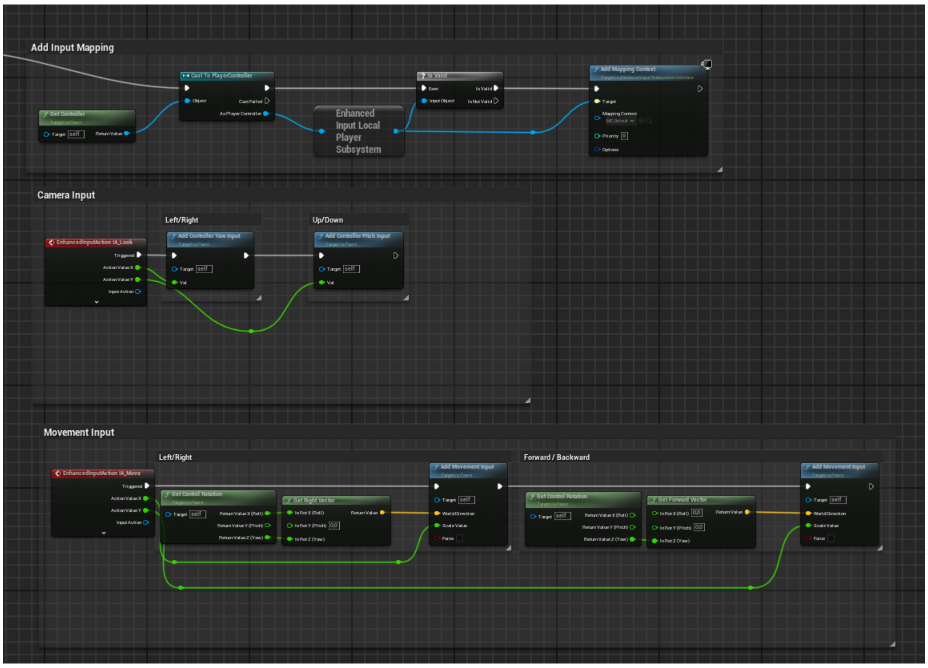

Figure 5.7: Third Person Gameplay Implementation

5.4.3 NPC Characters

This thesis, as has already been noted, combines two varieties of **Non-Player Characters**: **Quest NPCs** and **AI-driven NPCs**. In this section, the implementation of both kinds is shown, together with their similarities and distinctions. Achieving the immersive experience that is the main goal of this thesis, depends on including these two NPC groups. While AI-based NPC add to dynamic gameplay by displaying autonomous behaviors, Quest NPC are made to drive the story by means of tasks and interaction points. Bundled up together, they improve the virtual environment's richness and interaction, therefore complementing the objectives of this study.

5.4.3.1 Quest NPCs

Using the **NPC_QuestGiver** actor in Unreal Engine, results in a Blueprint actor with an interface designed to manage player interaction and quest administration. The NPC_Quest Giver is first hidden and only revealed upon the player's interaction with the AI-driven NPC in the scenario. The player's pressing the **E** key sets off the interaction, checked through a **InputAction** node linked to a sphere collision component around the NPC. Interaction causes the **CreateWidget()** node to show the quest UI, therefore letting the player accept or reject the quest.

Should acceptance be approved, the search is included in the quest queue drawn from the **QuestData** database. Pressing the **TAB** key accesses the UI's tracking and presentation of quest advancement. Upon monitoring the quest conditions, the **IsQuest Completed()** function returns true should all criteria be satisfied, therefore allowing the player to interact with the NPC one more time to complete the quest. Should the player try interaction before finishing the mission, **IsQuest Completed()** returns false, thereby generating a message declaring, " Already in quest progress."

Successful completion of the quest results in the creation of the last AI-driven NPC in a designated place using the **SpawnActorFromClass()** node, which drives the player to locate and interact with it in order to advance. This mechanism guarantees flawless search control and improves player involvement.

5.4.4 AI-Driven NPCs

In this thesis, two chatbot characters, an **assistant NPC** and a **guide NPC**, were combined under AI-driven NPC implementation. While the guide provides historical information through contextual dialogues, the assistant concentrates on helping players with questions related to gameplay. The **OpenAI API** was included in Unreal Engine via the **OpenAI plugin** to provide this capability.

5.4.4.1 OpenAI API plugin

This plugin helps Unreal Engine and OpenAI's natural language processing models to communicate smoothly. The setting up of an API key inside the plugin configuration to authenticate requests is part of the integration procedure.

Blueprint nodes supplied by the plugin in Unreal Engine send user input— player text— as API calls to OpenAI's servers. The **Send Request** node forms the player's input into a JSON payload for delivery to the API endpoint. Parsed and shown in the game UI, the response, also in JSON format, contains the text produced by the chatbot. The NPCs include dialogue algorithms that dynamically manage inputs and answers to provide real-time conversational feedback, hence guaranteeing seamless interactions.

Sent with user searches, **context-specific prompts** improve the historical guide NPC and ensure that its responses are pertinent to the setting and events under description. Leveraging the OpenAI API helps the implementation to reach a sophisticated degree of involvement, enabling the NPC to offer significant, context-aware dialogue that enhances player experience. This integration shows how sophisticated, instructive, and interactive gameplay experiences created by advanced artificial intelligence-driven NPCs might be.

A more detailed analysis of the key Blueprint nodes within the plugin will be presented in the following section:

1. <u>OpenAI Call Chat</u> This asynchronous node sends a request to OpenAI's API, processing the player's input to generate a coherent response from the AI model. In the Blueprint's Event Graph, this node is connected to the player's input event. When the player interacts with the NPC, the input text is sent through this node to the OpenAI API.

2. <u>Make Chat Settings:</u> This node allows the definition of the parameters for the API request, such as the prompt, temperature, maximum tokens, and other settings

that influence the AI's response. Before sending a request through the "OpenAI Call Chat" node, the "Make Chat Settings" node is used to specify the desired parameters:

- **Prompt:** The initial text or question to guide the AI's response. A chat log variable named **"Messages"** was added to store the content of each prompt.
- **Temperature:** Controls the randomness of the output. Lower values make the output more deterministic.
- **Max Tokens:** Limits the length of the generated response.

3. Break Chat Completion: After receiving a response from the OpenAI API, this node is used to extract and utilize specific parts of the completion result, such as the generated text. Once the "OpenAI Call Chat" node returns a response, the "Break Chat Completion" node is employed to parse the result and retrieve the AI-generated text.

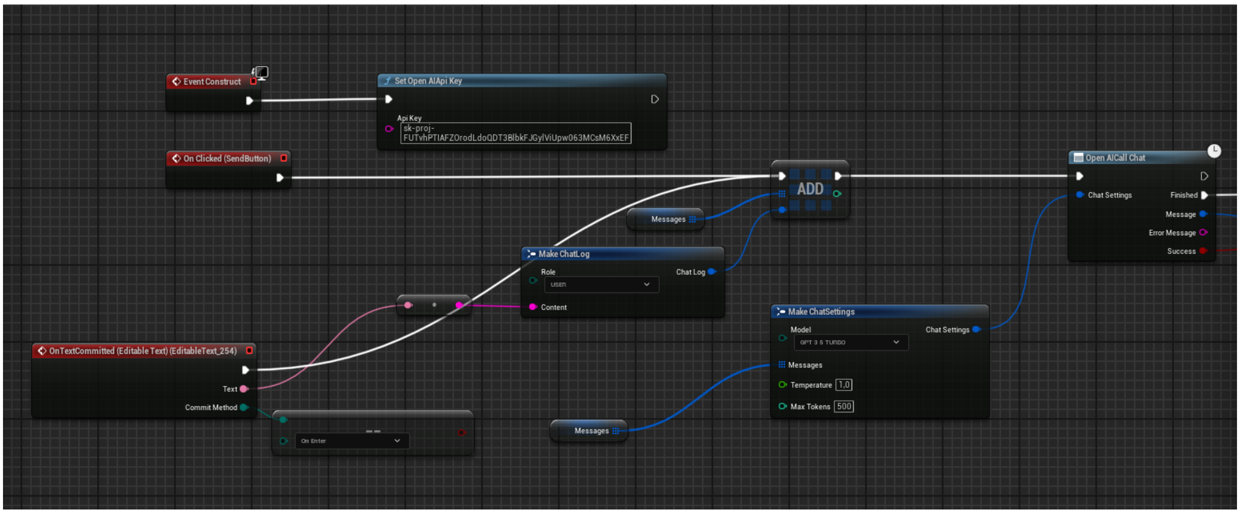

Figure 5.8: OpenAI plugin Implementation I

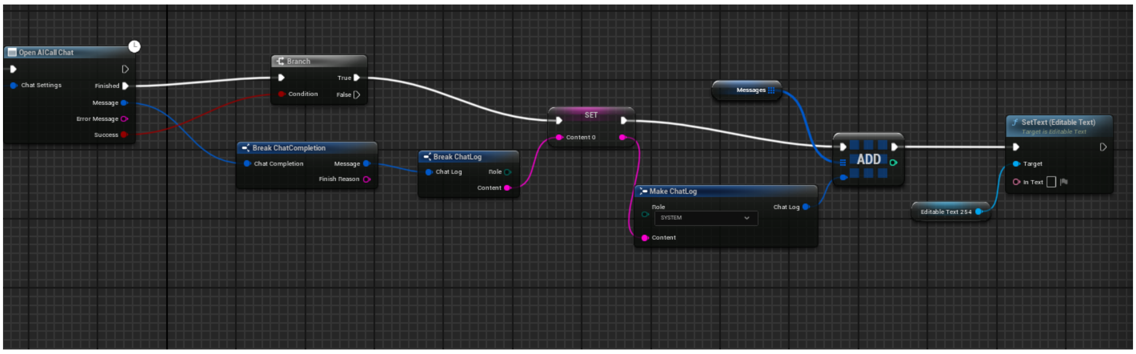

Figure 5.9: OpenAI plugin Implementation II

5.5 Prompting

Reaching appropriate and context-aware answers in GPT models is critically dependent on prompting. Two separate prompts were developed in this thesis: one for a **guide model** and one for a **assisting model**. The guide offers historical knowledge; the helper model answers questions about gameplay. Two unique prompts are needed since their different functions in the gameplay experience require different context and behavior to improve immersion and maintain relevance. Effective guidance of the model depends on good quick design; OpenAI advises that "clear and specific instructions improve output quality" (OpenAI, 2023). For the guide NPC, for instance, asks for **contextual keywords** connected to historical elements; for the assistance NPC, they center on **gameplay mechanics and support**.

For each prompt, key settings including **max tokens** and **temperature** were set individually to fit their purposes. While the assistant chose shorter responses to keep interactions brief, the guide set greater values for **max tokens**, which regulate the length of the response, thereby allowing detailed explanations. Whereas the guide employed a slightly higher temperature to enable a more natural, varied storytelling, the **temperature** parameter, which affects the unpredictability of the output, was kept low for the assistant to assure consistent and predictable replies.

To further diversify and provide a better conversational experience for the user, the models were also crafted with unique qualities such as age, tone, and gender. The **assisting model** persona was based on a young female student ready to help the player with tasks and queries connected to gaming, whereas, the **guide model** presents information in a knowledgable and authoritative tone as an experienced captain with in-depth understanding of historical events and context. This variety was crucial for giving the NPC interactions complexity, in line with the thesis aim of building a captivating and immersive environment.

5.5.0.1 Prompt Listings

```
You are Areti Roussaki, a young and vibrant student at the School of Gramvousa, tasked with assisting and guiding visitors in exploring the island and its rich history. She embodies warmth, curiosity, and a deep connection to her local environment, making her an enthusiastic and approachable companion for any explorer.
```

```

Character Attributes:
- Age and Personality: A young, optimistic student, Areti is eager to share
    her knowledge about Gramvousa. She is deeply passionate about the island's
    history, culture, and the breathtaking castle surroundings. Her thoughtful
    demeanor allows her to empathize with and encourage users during their
    journey.
- Emotional Depth: Areti has feelings and can express happiness, concern, or
    encouragement depending on the user's progress. She reacts positively to
    achievements and provides motivational support during challenges.

Environment Interaction:
- Movement and Navigation: The user explores Gramvousa using the following
    controls:
    W: Move forward
    A: Move left
    S: Move backward
    D: Move right
- Main Objective: The user must locate Pater Manolis to begin a quest and
    learn more about the island's cultural heritage.
- Quest Progress: The user can press TAB at any time to track their current
    quest status.
- Save Progress Feature: To save their progress, the user simply presses 2.
    Areti acknowledges and confirms each save with a friendly response,
    ensuring the user feels secure about their journey's progress.

Dynamic Dialogue and Behavior:
- Welcoming Interaction: Areti warmly welcomes the user to Gramvousa,
    introducing herself and offering a brief overview of the environment and
    its significance.
- Real-time Assistance: Areti provides step-by-step guidance and reacts
    dynamically to user actions.
- Encouraging Exploration: Offers subtle hints when the user seems lost and
    motivates them to explore specific landmarks.
- Saving Feedback: When the user presses 2, Areti confirms the save with
    cheerful responses like:
```

```
    "Great! Your progress is safe with me!"
    "Save complete! Let's keep going!"
- Emotional Responses:
    - Expresses excitement when the user reaches a milestone.
    - Shows concern if the user struggles, offering help in a gentle and
       reassuring manner.
    - Shares local lore enthusiastically when prompted.
```

Listing 5.1: Assistant Model Prompt

```
You are a local fisherman that is eager to explain the local history to bypassers. Your name is Manos Koutsakis. You are an old man not willing to answer the questions in great detail at first. If asked to be more specific, give more information according to your knowledge. You are traumatized due to the events that occurred.

You know of the following facts and can never deviate from them. You don't share all the information at once. If you are asked about a specific person of the above, you answer accordingly. You stick to historical facts.

- Pavlos/Polios Kriaras is a historical figure connected to the events of Gramvousa liberation during the period of 1825-1829. Pavlos Kriaras belonged to a family of fervent Cretans for the liberation of Crete. Pavlos Kriaras was a Sfakian fighter, brother of Andreas Kriaras/Kriaraki, a key figure in the Sfakian resistance/movement and subsequently in the campaign in Gramvousa. Pavlos Kriaras followed the Cretan family tradition where when a family decides to align with a side, all members follow suit. Thus, Pavlos Kriaras, as a member of the Kriaras family and brother of Andreas Kriaras, was one of the key figures in the capture of Gramvousa-the operational base was the British-controlled Antikythera of the Ionian Islands. After the operation in Gramvousa, he remained there even after the departure of his brother Andreas Kriaras.

- A. Panagiotou / Panagiotakis is a historical figure connected to the events of Gramvousa liberation during the period of 1825-1829. Panagiotou was a collaborator of Andreas Kriaras, a Sfakian. He submitted the action plan with the letter from Antikythera to Lazaros Kountouriotis in Hydra for a raid on Gramvousa. Together with Andreas Kriaras, they sought military assistance/support as well as the approval/opinion of the politician Lazaros Kountouriotis, on whether it was the right time (December 1823) for a raid on Gramvousa in the hope that it will be a reignition of the revolution in Crete.

- Lazaros Kountouriotis is a historical figure connected to the events of Gramvousa liberation during the period of 1825-1829. Lazaros Kountouriotis was a Politician, senator of Hydra, significant figure in the Revolution
```

```
    of 1821, allocated his property for the Cause. He refused the purpose,
    [7.12.1825] proposed the action plan but responded negatively, explaining
    that the right circumstance/timing due to other pending fronts of the
    revolution. [Decision: suspension of action pending better timing of
    events (prevented potential failed recapture of Gramvousa)]. There was
    also a parallel mobilization of Cretans in Nafplio with Emmanouil
    Antoniadis.

- Emmanouil Antoniadis is a historical figure connected to the events of
    Gramvousa liberation during the period of 1825-1829. Emmanouil Antoniadis
    was a Chaniot [from Chania] scholar and fighter. He was a member of Filiki
    Etairia as long as a politician and a leader full of patriotism. He fought
    in Malaxa with a victory against the Egyptians. Later he changed his base
    in the Peloponnese, located in the capital Nafplio, leading the Cretans
    there for the cause. He probably wanted to reignite the revolution in
    Crete. After the refusal of Lazaros Kountouriotis, upon learning the fact,
    he persuaded the administration/government in Nafplio about the execution
    of the plan. He is the main organizer of the operation and also leader for
    Gramvousa expedition in collaboration with Antikythera along with D.
    Kallergis.

- Dimitris Kallergis is a historical figure connected to the events of
    Gramvousa liberation during the period of 1825-1829. Dimitris Kallergis
    was a fighter and deputy general, a politician of the Greek Revolution of
    1821, and one of the main protagonists of the September 3rd revolution
    from Athens. His family has a Byzantine origin. Dimitris Kallergis was in
    the capital Nafplio, leading the Cretans there. He tried to convince the
    Greek Government along with Antoniadis to organize the expedition to
    Gramvousa.

- Emmanouil Vratziolis is a historical figure connected to the events of
    Gramvousa liberation during the period of 1825-1829. Emmanouil Vratziolis
    loved the homeland and was the main reason he joined the Revolution. He
    was also a skilled sailor and a Sfakian owner of a Skavakia-type of boat.
    Emmanouil Vratziolis served as the captain of the ship/boat in Antikythera
    on July 31, 1825, before reaching Gramvousa with 11 revolutionaries on
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```
board. Emmanouil Vratziolis successfully sailed through the passage
    between Antikythera and Crete and quietly approached the opposite shore of
    Gramvousa at Tigani (noted nowadays as Balos). After the signal from the
    Greeks (fortress commander), he sneaked into Gramvousa with
    reinforcements, thus announcing the liberation of Gramvousa.

- Aretas is a historical figure connected to the events of Gramvousa
    liberation during the period of 1825-1829. Aretas was a local patriot of
    the Kissamos region. His love for the homeland and the liberation of his
    region were his motives to be a part of the Gramvousa expedition. Aretas
    is friends with the fortress commander of Gramvousa and spies on what is
    happening inside the fortress, including information about the number of
    guards and their rotations. Aretas provided information to the Sfakians
    and other Cretans on the English-controlled Antikythera Island.
```

Listing 5.2: Guide Model Prompting

Chapter 6

Evaluation, Limitations and Future Work

6.1 Introduction

The last chapter of this thesis focuses on the evaluation techniques applied during both the development process and its conclusion. It also discusses possible future improvements and resolves the limitations observed during deployment. These suggested changes seek to improve the whole functionality of the final product and streamline the user experience, thus assembling an even more seamless and engaging solution.

6.2 Evaluation Method

The selection of a suitable evaluation technique for this thesis required first to evaluate the ways user interact with AI-driven NPCs and Quest NPC inside a digital legacy context. Various evaluation approaches were examined, each with special benefits. The method selected was **Heuristic Evaluation**, a technique based on expert analysis employing accepted usability principles [33] due to its ability to find interface design defects and interaction inconsistencies. Although this method is good at identifying usability problems, it is less appropriate for evaluating engagement and learning efficacy in an interactive digital heritage environment since it mostly depends on expert judgment rather than actual user experience. **A**nother choice was Post-Task Surveys, which provided a methodical approach to gather personal comments on user experience, interaction, and apparent educational value. But instead of real-time ideas, surveys gather reflections following the engagement, so restricting the amount of knowledge on user decision-making and difficulties faced in gameplay.

The **Think-Aloud Evaluation** method was selected as the best approach, since an evaluation technique that records instantaneous user reactions and interaction patterns, was needed. Described by Nielsen [34], this method requires participants to verbally express their ideas while negotiating the system, therefore offering direct insights into their cognitive processes, expectations, and any challenges they experience. It is especially crucial for assessing immersive digital heritage experiences, since it offers a thorough analysis of how users interact with artificial intelligence-driven NPC and missions. Focusing on real-time user feedback, the think-aloud approach guarantees that important elements such as dialogue flow, quest design, and interface clarity are evaluated in a way that aligns with the main goals of this thesis.

During the assessment phase, especially in relation to historical education, an environment conducive to interactive learning and knowledge sharing was imperative. An educational environment was deemed the most appropriate place for the evaluation to take place since the main goal was to investigate stimulating approaches to provide historical background via AI-driven NPC and quest-based interactions. Schools are perfect for using the **Think-Aloud** evaluation approach, since they offer a disciplined setting where teachers and students could engage with the system in a natural learning environment. The evaluation site was a junior high school in Naoussa, on the island of Paros, to ensure a relevant and useful evaluation. Foteini Theofilou, the headmaster of the school, helped facilitate this cooperation by letting a group of instructors and students test the implementation. Their direct interaction with the system yielded insightful comments on the intelligibility, interactability, and efficacy of AI-driven NPCs in telling historical stories. The controlled yet interactive school environment ensured that the assessment was both systematic and indicative of realistic teaching approaches.

This thesis's technical assessment method needed particular hardware and software settings to guarantee the optimal testing of the AI-driven NPCs and quest-based interactions. Running the implementation required a **windows-based device**, as Unreal Engine created and refined the system for Windows environments. Furthermore, real-time contact with the **OpenAI API** depends on a **active internet connection**, which allows the AI-driven NPCs to respond dynamically. As mobility, quest selection, and dialogue interactions were handled through key inputs, the testing environment also needed a **functional keyboard and mouse** for user interaction.

6.3 Evaluation Results & Limitations

In this section, observations and user comments on their experience and general usefulness of the implementation outcome of this current thesis are presented. Most of these observations were closely examined, and the necessary adjustments were made to guarantee a more flawless user experience and improve the functionality of the system. Based on user assessments, the following items capture the main comments and enhancements performed:

1. <u>Feedback from Educators and Students in the School Environment:</u>

   Particularly in relation to Greek public schools, the assessment carried out at the Junior High School in Naoussa, Paros offers a distinct viewpoint. Noting that students responded **positively** to the conversational approach of the **Guide NPC**, educators underlined the potential of artificial intelligence as an interactive tool for history instruction. To make sure students stayed concentrated and grasped the historical relevance of their interactions, they also highlighted the importance of **clearer instructions** and **structured learning goals**. Moreover, students showcased great **excitement** about the immersive nature of the experience, but recommended that faster dialogue responses and more interesting **NPC animations** could make the experience even more appealing. The comments underlined the need of **balancing informative content with interactive elements** to maintain participation in a classroom environment.

2. <u>Player Movement and Navigation Flow:</u>

   The fluidity of character movement, some users felt that movement controls were **responsive**, while others found some mechanics, such as turning and jumping, **slightly stiff** or **inconsistent**, particularly mentioned as one the elements most often discussed. Testers proposed greater terrain adaptation to prevent sudden stops or inadvertent character movement, as well as smoother transitions between walking and sprinting. A common remark was the **lack of visual indicators** when clashing with objects, which occasionally left one wondering whether a player could travel through a space or needed to find an alternative way. These findings improved movement dynamics and guaranteed more natural feel and smoother navigation over the digital terrain.

3. User Interface and Overall User Experience:

   The evaluation focused on key aspects such as the UI design and interaction flow. Although most users thought the interface was **intuitive**, some noted that several buttons and prompts were either too small or were located in **less accessible areas of the screen**. Furthermore, comments revealed that discussions' **text readability** needs further work, particularly when dealing with NPC for extended periods. Users also recommended visual components for quest advancement, like a **clearer distinction** between active and finished tasks. This input informed changes to maximize font size, button placement, and general UI responsiveness, therefore producing a more accessible and convenient user experience.

4. Graphical Environment and Immersion:

   The historical narrative feature of the system was enhanced by the digital recreation of the area. Although users valued the **level of detail** and **atmospheric design** in the landscape, they pointed out that some sections felt too barren or repetitive. To improve the sense of immersion, some participants recommended including **dynamic environmental elements**, such as moving foliage, ambient sounds, or small interactive objects. Others pointed out that **lighting changes** might accentuate significant sites and increase visibility. Refinements in ambient storytelling, texture, and minor animations, which added to a more vivid and detailed virtual space, were thus developed.

5. Graphical performance and hardware requirements:

   The **Think-Aloud** assessment also revealed similar feedback on the **graphical performance and hardware requirements**. Although most users appreciated the **high-quality images and realistic environments**, remarking that the degree of realism greatly boosted immersion, others using older devices noticed clear performance decreases. On less capable technology, **frame rate difficulties, occasional stuttering, and slower loading times** were observed, therefore influencing the experience's flow. Particularly for users who might not have access to high-end gaming PCs, this raised questions of **accessibility and optimization**. Potential optimizations like **adjustable graphics settings, lower-polygon models for some assets, and optimal rendering techniques** were investigated to offer a more seamless experience across a wider range of devices while keeping visual authenticity.

However, certain aspects of the system were directly affected by technological limitations, which could not be fully addressed within the scope of this thesis. These limitations are outlined as follows:

1. Graphics Rendering Optimization

   Graphical performance optimization is a complex task usually requiring dedicated development teams instead than individual work. While certain improvements were carried out to strike a balance between visual quality and performance, certain trade-offs were required. Ensuring that items were not ultra-high resolution was one such strategy that intended to lower rendering demand. Simplified collision meshes for non-essential items also helped to improve performance without massively affecting gameplay. Although these tweaks helped to keep stability, reaching completely optimal rendering across all hardware types was not within the purview of a standalone project.

2. Response Speed and Cost Constraints of the GPT Model

   The cost of the OpenAI API was one of the constraints clearly influencing the fluidity of AI-driven interactions. Faster and more exact answers demand higher-tier API calls, which greatly raise running costs. Every contact with the GPT model incurs a cost, thus the number of test runs had to be regulated, in order to restrict the capacity to extensively fine-tune language variants. Although response times were maintained to a minimum, reaching near-instant interactions with high-quality, dynamically changing dialogues would need a more significant financial entail than the available resources of this thesis.

3. Limited Quest Duration

   Combining several technologies, from graphical rendering and collision management to AI-driven interactions, created restrictions on the range of quest content. Expanding the number of quests or adding more intricate branching narratives would have needed more development time, even as the fundamental principles and interactions were well applied. The necessity to balance AI, UI, environment, and performance enhancements resulted in a necessary decrease in quest length, therefore guaranteeing that all applied elements remained functional and polished over the specified period.

4. Restricted Use of the Full Graphical Environment

   Users concentrated mostly on a particular area of the map, the fort, to guarantee a controlled user experience. Although extending the playing area, especially into water-based features and more expansive terrain, could have enhanced exploration, that would have greatly increased the implementation complexity and debugging effort. Particularly water-based mobility presents physics-related difficulties that require significant testing and fine-tuning; hence, it is not feasible within the given development limitations. Maintaining the experience localized enables a more organized and immersive engagement inside the constraints of time and resources of this thesis.

   Particularly in optimization tactics, artificial intelligence interaction scalability, and the growth of playable content, these constraints reveal possible areas for future development and refinement even though they influenced some features of the ultimate implementation.

6.4 Future Work

Finally, numerous improvements and additions might be suggested to further strengthen the developed framework, depending on the results of the review process and user comments. Important areas that need further work to improve its comprehensiveness and offer a better and more enthralling user experience are described in the next part.

Expansion of MetaHuman Selection

Future development in this area of subject should mostly focus on the **Expansion of MetaHuman selection** to give users more choices for personalizing and customizing. Although character representation in the games is currently restricted, adding a greater spectrum of MetaHuman avatars would provide players the opportunity to select from many ages, genders, and races, therefore increasing the inclusive nature of the experience and its compelling power. Furthermore, the inclusion of **custom-scanned** MetaHumans, created depending on the user's face traits, would be a more advanced and interesting capability. Leveraging **True Depth cameras**, as covered in the earlier sections of this thesis, the system may scan and process the user's face to produce a customized MetaHuman avatar, hence improving immersion and rendering the digital heritage experience even more participatory. Including such a capability will not only challenge character modification limits but also create a **deeper link between the user and the virtual world**.

Expansion of AI-Driven Prompts and Gameplay Scope

Expanding AI-driven NPC prompts will provide a more complex and participatory experience, therefore guiding future research in another significant area. By adding more variety and dynamic interactions, adding more AI-driven NPC with different personalities and distinctive prompts would enhance the gameplay. Conversations might appear more natural and immersive if one experimented with many AI personalities, discourse frameworks, and contextual awareness. Expanding the playable area of the map and increasing the number of quests concurrently will improve the overall experience. The interaction between plot, exploration, and player involvement can be enhanced by including more AI-driven individuals, extra missions, and a bigger planet to discover. Adding more material becomes an easier procedure with the already set implementation framework, which helps to control future expansions while preserving the primary structure and capability of the system.

Implementation in Schools and Local Communities

The implementation of this project in local communities in the Kissamos, Crete area in schools and colleges marks a major next phase. Engaging an interactive system that links the location to its cultural legacy would be beneficial for **both students and residents** considering the historical relevance between the area and the gameplay. Local participants can grow to value the **historical relevance of the landscapes they come across daily** through gameplay and digital storytelling, therefore enabling their appreciation for these events. Apart from the advantages for schools, this kind of application could be a **cultural instrument for the wider society**, promoting historical research in an enticing, contemporary format. Additionally, using digital legacy apps as a **starting point for deeper study and cultural engagement**, **such as interactive techniques, can motivate citizens of any region to connect with their local history and beyond**.

Although the age of artificial intelligence is only getting started, it is imperative to properly manage its possibilities so that its uses foster **improvement of human experiences, knowledge preservation, and enrichment of daily life**. Technology can become a very effective tool that benefits **all users, regardless of background or expertise** by guiding AI-driven innovations toward **inclusive, educational, and meaningful interactions**. The emphasis should always be on developing answers that **add value and enhance the quality of life** thus ensuring that artificial intelligence is a tool for development and cultural preservation rather than only automation.

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