From Trends to Experiences: Co-Creation with Generative Artificial Intelligence in Developing Interactive Multimedia Applications.

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Abstract

The emergence of generative artificial intelligence (GenAI) tools has ushered in new possibilities for creating diverse content, encompassing text, images, sound, videos, 3D objects, and even code for programming languages. Within this dynamic landscape, both significant challenges and opportunities arise in the field of interactive multimedia application development. It is imperative that the evolving trends in the utilization of these tools metamorphose into experiences that not only reflect but also facilitate the replication of models, methods, and development approaches. This paper contributes to the academic discourse by presenting three distinct development experiences. Each experience represents the initial steps of an incremental exploration process, thus contributing to exploratory research in this domain. These experiences are presented as case studies, with the first one analyzed retrospectively, and the latter two deliberately designed to scrutinize the challenges and opportunities associated with integrating generative artificial intelligence into the software development process, playing a significant role in a co-creation process. The results presented are qualitative, with detailed independent analyses for each case study, offering a comprehensive description of the findings. Thus, this paper presents a set of recommendations facilitating the transfer, replication, and improvement of these experiences by other multimedia development labs or teams.

Keywords: Generative Artificial Intelligence, Prompt Engineering, Multimedia Development and Production, Interactive Multimedia Applications, Co-Creation.

1 Introduction

Generative Artificial Intelligence (GenAI) has been a research field with relevant advances after years of work [1, 2, 3, 4]. In recent years/months, the popularization of tools like ChatGPT and the viral post of images, audios, and videos on social media have brought attention to what most people have labeled as *"Artificial Intelligences"*, generating all kinds of comments that have led to an exaggerated questioning of their use or a glorification of their potential [5, 6, 7, 8, 9]. Indeed, like any other technological tool, GenAI tools provide important development alternatives that, when used appropriately, can deliver significant advancements in various application sectors. However, it is necessary to understand their limitations and potential risks in their use.

In general, a GenAI tool is supported by a Large Language Model (LLM), which, in brief, is conformed to a wide knowledge base, a machine learning algorithm, specifically deep learning; an output production system and a natural language communication interface based on text [10, 11, 12]. Each text input written by a user interacting with a Gen tool is called a *"prompt"*, leading to the coining of the term *"prompt engineering"*. It is important to clarify that the terms GenAI and LLM have academic origins, hence their wide acceptance in this sector, unlike the term *"prompt engineering"*, which has been more readily accepted by the general public but has encountered detractors in the academic realm.

"Prompt engineering" can be defined as the process of creating effective text inputs, called *"prompts"*, for GenAI Tools, enabling suitable outputs considering the initial requirements [13, 14, 15]. This process involves crafting *"prompt"* inputs or instructions that guide the understanding and generating outputs

from the AI model [16, 17]. Furthermore, the design of *"prompts"* influences the quality, relevance, and coherence of the input data in the expected output. In this regard, ChatGPT[1] defines *"prompt engineering"* as *"the process of designing and refining prompts in natural language processing systems to guide accurate responses from the models."*. Although this concept is relatively new and unclear, Gemini (previously Bard)[2] defines that *"prompt engineering is essentially the art of crafting instructions for artificial intelligence (AI) models, particularly generative AI models, to get the desired outputs. These instructions, called prompts, are essentially questions or starting points that guide the AI in the right direction."*. The discussion arises because some sectors have elevated the capabilities, knowledge, and skills required to write a *"prompt"* to the same level of depth as technical or professional training. Without delving into that debate, what is clear is that having expertise in *"prompt engineering"* is becoming a desirable asset in today's job market.

Undoubtedly, multimedia production is one of the areas most affected by the current boom in GenAI tools. Clearly, the capability to generate images, videos, sound, and 3D models through text input changes the creation time and workflow in multimedia content production. Similarly, this occurs in developing interactive multimedia applications, where using GenAI presents challenges in the already difficult collaboration between multimedia content creators and software developers. One of the approaches proposed and adopted in this paper is to integrate GenAI tools as another actor in the development process, as part of the team, and as a co-creation between AI and the human team. This paper presents a contribution in this direction. This work shows three co-creation experiences between GenAI and the creation/development team under a case study analysis. It is important to note that this article does not present results from a finalized research. On the contrary, it shares the journey that has allowed moving from trends in the use of GenAI towards replicable development experiences, describing how workflows and development methodologies were adapted to include GenAI tools as part of the development/creation team. Section 2 provides a state-of-the-art review with a selection of works that have studied co-creation with GenAI tools in multimedia applications, specifically video games and immersive experiences, i.e., virtual reality, augmented reality, mixed reality, and extended reality. Section 3 describes the three case studies, the three development experiences, their motivations, or case design, work proposal, and key findings. Finally, Section 4 presents concluding remarks and reflections on future work, inviting further contributions and academic discussion in this research direction.

2 Related Work

General Artificial Intelligence (GenAI) tools for non-expert users in computing have opened new possibilities for content creation such as text, images, sound, 3D objects, and even code for programming languages. The idea is that just a natural language text input, without significant restrictions, provides significant alternatives for interacting with these systems. This possibility has sparked interest in both the academic and productive sectors, seeking the best alternative to leverage the advantages offered by these tools. In academic discussions, the number of preprint articles published on platforms like arXiv is evidence of the speed at which this topic develops. Another example is the proposal of tracks in academic conferences where GenAI, Large Language Models (LLM), and Prompt Engineering are keywords. To give an example, in ACM CHI 2024[3], there are about nine workshops in this related topic, among which we can highlight GenAICHI 2024, which will hold its third edition [18, 19]. One of the approaches that has garnered significant attention is understanding GenAI tools as part of the content creation/production/development team under the concept of human-AI co-creation [20, 8].

One of the first works that introduced a co-creation approach with AI systems was the proposal by Wu et al., who presented the concept of AI Creativity as the ability for humans and AI to co-live and co-create by playing with each other Wu2021. Thus, in state-of-the-art, proposals for co-creation between human teams and GenAI tools can be found for image composition[21], musical composition [22, 23], narrative writing [24, 25], video game development [26], immersive application development [27, 28], among many more.

Due to being an emerging technology, few works present co-creation studies with test subjects. Turchi et al. studied how interaction with GenAI tools impacts creativity, analyzing feedback from groups of design students developing an architectural project with the help of GenAI [29]. The results demonstrate the potential use of these tools, and the authors question the pros and cons of these tools [29]. Jonsson et al. present a study exploring the use of AI tools for code generation in a group of university students [30]. The authors claim that participants seek correct syntax in their prompts with the tool, where trial and error constitute the best tool for refining the ability to write better prompts [30]. Guo et al. present an observational study in a workshop where designers and generative AI collaborated in creating a design [31].

[1] ChatGPT, OpenAI, https://chat.openai.com

[2] Gemini, Google AI, https://gemini.google.com/

[3] `https://chi2024.acm.org/for-authors/workshops/`

The authors propose that AI and designers should evolve collaboratively, and designers should understand and adapt to innovative technologies like AI [31].

For the same reason, some proposals in the state-of-the-art are speculative. Huang presents a reflective proposal suggesting a path to explore how GenAI would transform co-creation between humans and computers in the next 10 to 15 years through design fiction and playful critical design [32]. Zhu et al. present a vision paper proposing a new research area called eXplainable AI for Designers (XAID), specifically for game designers [33]. The proposal is based on the need for AI tools in the co-creation process not only to present results but also to explain the reasoning behind their outputs [33]. Allen et al. present a proposal based on crowdsourcing, showing a possible integration of actors with GenAI under a collaborative approach [34]. Schmidt et al. present a general proposal on how GenAI tools can be used in the design process and in which areas they can replace and improve human contribution [35]. The authors emphasize that the approach should be transparent for clients or stakeholders in a commercial environment [35]. This work presents a real experience of development using a co-creation approach with GenAI tools but does not include subject studies. For this reason, the findings are the result of real cases with some speculations in recommendations and further work.

3 From Trends to Experiences

This section presents three exploratory case studies describing experiences in the development of interactive multimedia applications, including two experiences for VR and a 3D video game. The first case study resulted from a retrospective analysis. The need to address a real solution led to the involvement of GenAI tools in the development of the interactive museum experience. After the development was completed, an analysis of the development team's experience and its relationship with GenAI tools was conducted. Following this initial case study, the following ones were proposed.

In the second case, an Endless Runner video game, the decision was made to explore the potential of GenAI tools, minimizing but not eliminating human intervention. It is clarified that in this second experience, the use of GenAI tools was oriented towards conceptualization, asset generation, launch planning, and testing, leaving the entire coding process to the human team.

The last case study was designed by involving a specialty coffee enthusiast, acting as a stakeholder, validating and questioning the contributions of GenAI tools. In this final experience, more tools were involved and AI was integrated into some coding elements. The three case studies are presented in three sections: motivation or case design, development, and key findings identified after the process analysis.

3.1 Exploring the Solar System: An Interactive VR Installation from a Science Museum

This co-creation and experimentation experience takes a first step towards generating content by simulating 3D objects through GenAI tools, with a significant addition through the integration of *"prompts"* in DALL-E 2[4]. This component integrates with *"prompt engineering"* into the virtual VR environment in Unity 3D, offering immersion and learning of the solar system. Fig. 1 showcases a screenshot of the generated content running in Unity 3D.

3.1.1 Motivation

The initiative arises from the need to optimize times in the 3D modeling and texturing process and the integration into the experience development environment. Collaborating closely with the Universidad Autónoma de Zacatecas and the Multimedia Research Group of the Universidad Militar Nueva Granada, with a multidisciplinary team seeking to transcend the conventional limits of teaching through an enriching and immersive experience for one of the sections at the ZigZag Museum, Science, and Technology Center.

3.1.2 Development

The initial phase of the co-creation process involved experimentation focused on generating panoramic images using GenAI capabilities from *"prompt"* inputs in DALL-E 2. This integration allowed fast and accurate creation of realistic textures, simulating being inside a spaceship, bringing an additional layer of detail and customization to the experience. Simplifying the 3D modeling process of the ship in a panoramic image with transparency was later imported into Unity 3D as a texture of a capsule mesh, generating an experience of being inside a spaceship with a view of space.

DALL-E 2, renowned for its ability to generate images from text descriptions, was seamlessly incorporated into our creative process. The specific prompts, which vividly described astronomical elements, allowed for an

[4]DALL-E 2, OpenAI, `https://openai.com/dall-e-2`

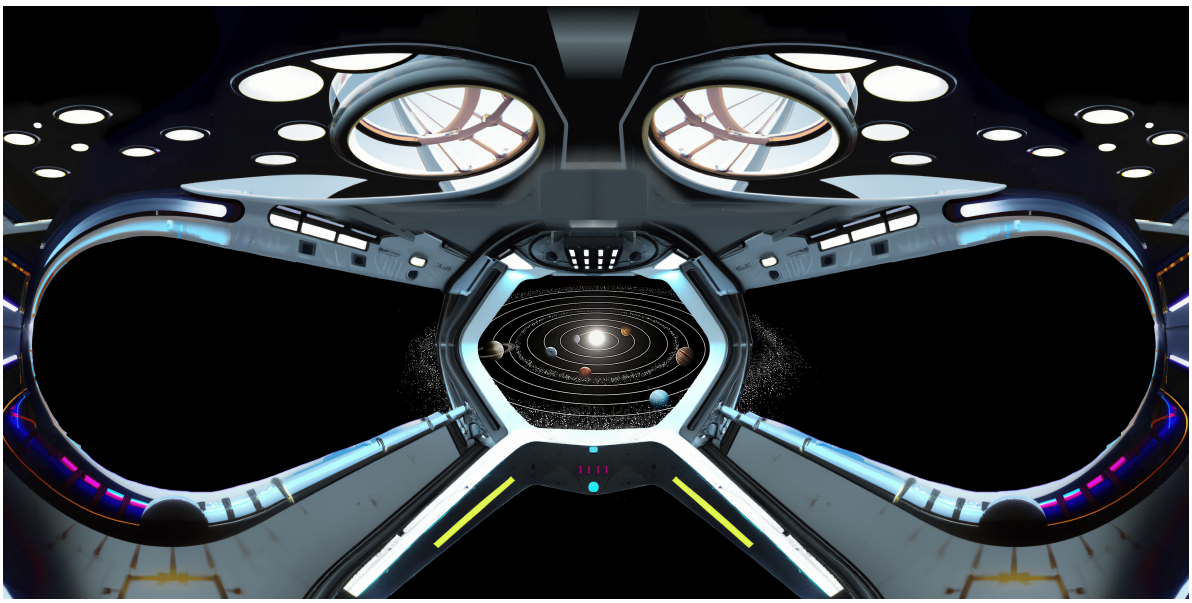

Figure 1: A view of the environment inside the spaceship, generated by Dall-E 2.

agile and rapid generation of comprehensive and contextualized visual content. This integration proved to be a valuable tool in the *"prompt engineering"* of the project, accelerating development without compromising the quality of the image and concept. Fig. 2 presents a realistic spaceship cabin created by integrating a panoramic image as a 3D mesh texture. Details include shiny metallic panels, illuminated controls, and a window showcasing a stellar landscape, generating a feeling of complete immersion.

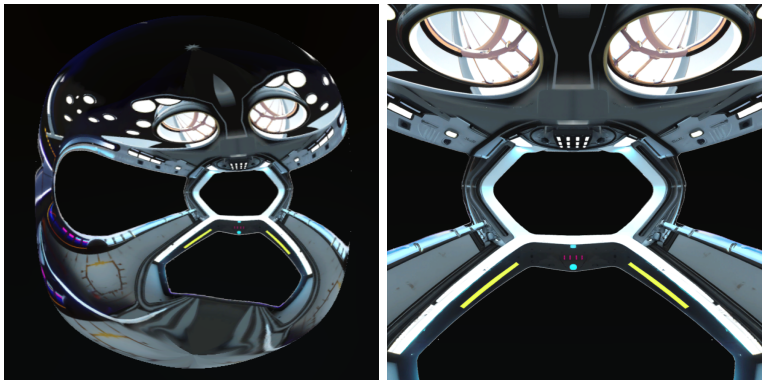

Figure 2: Spaceship cabin illusion crafted by integrating a panoramic image as a mesh texture.

3.1.3 Key findings

The resulting generation provided an attractive aesthetic. The visual quality of the panoramic image, powered by GenAI and DALL-E 2, was characterized by its realism, detail, and the speed with which it was achieved. The successful convergence between concepts for developing immersive environments and GenAI as an emerging technology was highlighted, with an emphasis on *"prompt engineering"* through the integration of *"prompts"* in DALL-E 2. The synergy between VR technology and GenAI opened new avenues for continued exploration of *"prompt engineering"* tools in the efficient development of immersive experiences.

3.2 Cosmic Run: Guardians of the Balance, An Endless Runner Video game

The constant evolution in video game development has led to exploring innovative technologies to improve the user experience. The implementation of GenAI in the production of An Endless Runner details how this technology has collaborated within the process to generate ideas and visual content. Envisioning *"Cosmic Run"* experience, GenAI was considered as a tool to significantly improve gameplay. The goal was to not only

develop a traditional game, but also set new standards in game adaptability with GenAI. Fig. 3 showcases a screenshot of the video game running in Unity 3D.

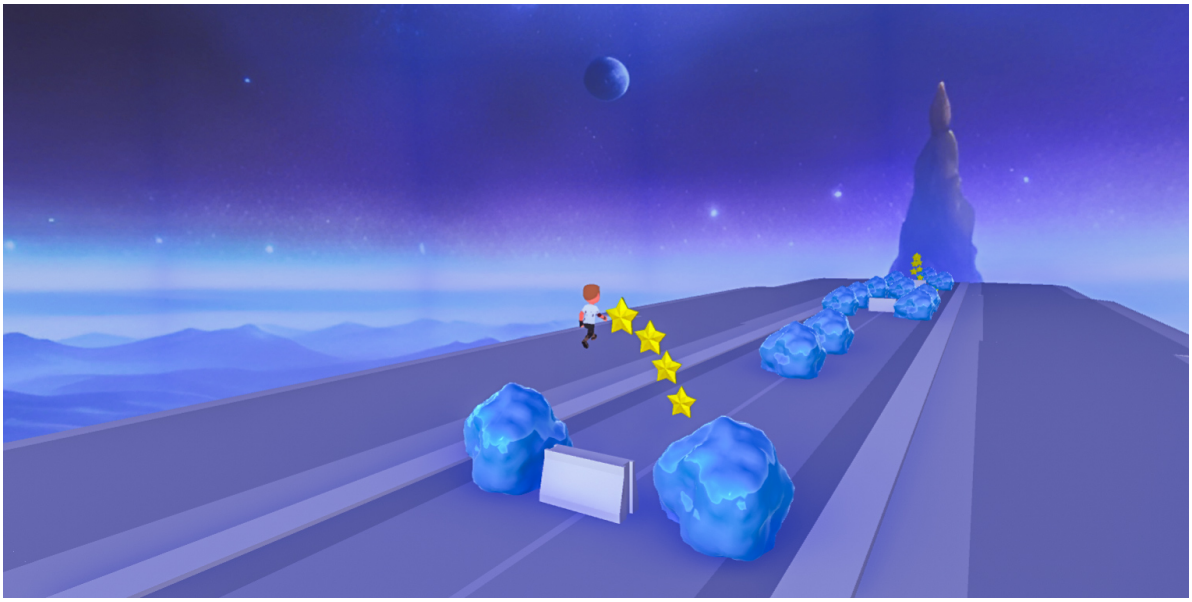

Figure 3: Overview of the integration of content generated by *"prompt engineering"* with GenAI tools in the video game.

3.2.1 Motivation

Production of a *"Cosmic Run"* presented unique challenges in terms of environmental variability. This genre has proven its appeal by providing fast, exciting, and accessible gaming experiences to a wide audience. However, exploring video game development with agile development and GenAI integration empowered us to experiment, dynamically evaluate, and adapt the development process. This strategic integration of GenAI tools was essential in addressing challenges and elevating the game's overall quality.

3.2.2 Development

GenAI was implemented to streamline the generation of resource generation, providing a gaming experience. Its real-time adaptability enabled not only the dynamic deployment of game elements but also the customization of difficulty and play style based on initial requirements and the collaboration with GenAI tools. ChatGPT and Skybox AI[5] were used, especially in the conceptualization and the creation of assets of the video game. ChatGPT generated ideas and scripts for the characters, while SkyBox AI created realistic 3D environments. These tools allowed the development team to create a video game with an engaging narrative and visuals.

Additionally, GenAI's ability to directly generate art assets not only facilitated faster graphical production times but also allowed for greater flexibility and adaptability in the game development process. The team was able to focus their efforts on other critical aspects of the game's design and gameplay, eliminating the need to manually create each visual element. This co-creation capability with GenAI tools contributes to improving the player experience by allowing for greater diversity and complexity in the game's visual elements. As a result, the game environment was able to dynamically evolve and adapt.

3.2.3 Key findings

The integration of GenAI is transforming the video game industry by opening a range of possibilities for the creation of more immersive and engaging experiences. Generating infinite and dynamic procedural levels allows for a unique gaming experience, suggesting that the application of GenAI tools in game development is helping to raise the level of quality, originality, and creativity.

Furthermore, the variety of creative outputs generated by GenAI has contributed significantly to the integration of video game aesthetics. This implies that AI tools are not only being used to optimize processes, but also to enrich the visual and artistic experience of the game. On the other hand, it stands out that

[5]Skybox AI, Blockade Games, Inc., `https://skybox.blockadelabs.com`

Figure 4: Screenshots of the Cosmic Run running on Unity 3D.

the automation of repetitive tasks through GenAI, such as idea generation, narrative, character creation, visual style, scenarios, 3D models, audio, images, videos, code, and others, allows developers to explore new aesthetic and create games with their own visual identity, freeing up time to focus on other aspects of video game development.

Appendix A.1 provides more details of the experience development process.

3.3 Coffee Masterclass: An Immersive Experience to Enjoying the Specialty Coffees World

"Coffee Masterclass" is an immersive experience powered by GenAI's cutting-edge capabilities. This designed training experience is aimed at a diverse audience, from coffee beginners to seasoned hobbyists and professional baristas, on how to brew coffee with the V60 method, imparting step-by-step coffee brewing knowledge. The V60 method is a pour-over coffee brewing technique known for its simplicity and precision. Using a V-shaped cone and paper filters allows for meticulous control over every aspect of the brewing process, from water temperature to pouring speed and direction. Consequently, it produces a uniform and thorough extraction of coffee flavors, generating a balanced cup. It is a popular choice among coffee enthusiasts who value quality and consistency in every brewed cup.

"Prompt engineering" techniques with powerful GenAI tools were used to generate a library of assets. The integration of these assets in Unity 3D as a platform for the development of virtual reality. Fig. 5 shows a screenshot of the experience executed in the Meta Quest 2 platform, showing the fusion of GenAI from *"prompt engineering"* and creative ingenuity. From the intricate and detailed build process of the V60 to the visuals and navigation, every aspect is generated with GenAI tools.

Figure 5: Overview of the integration of content generated by *"prompt engineering"* with GenAI tools in Unity 3D for VR experience. All assets were generated by GenAI tools.

3.3.1 Motivation

The immersive *"Coffee Masterclass"* experience arises in response to the fascination with coffee and the desire to provide lovers of this drink with an immersive experience. In turn, it is related to exploring the potential of GenAI tools for developing VR experiences from an agile and efficient framework, both in the design and development stages and content production.

3.3.2 Development

The development of the *"Coffee Masterclass"* unfolded through a four-stage process. In the planning, the content of the masterclass was precisely defined, establishing the objectives, characteristics, and the desired user experience. In this stage, an exhaustive selection process was undertaken to identify the most suitable GenAI tools for each multimedia resource type. This methodical approach aimed to guarantee an optimal alignment between the chosen tools and the overarching project objectives, setting the stage for a seamless integration of technology and creativity.

Harnessing the power of GenAI, a wide range of high-quality multimedia assets were produced, including realistic images and videos capturing the visual essence of the coffee brewing world, scripts for user interaction and experience logic immersive representations of 3D models, which provide realistic visual experience, realistic materials for the different elements of the virtual environment, which increase the feeling of immersion. Using a suite of LLMs tools, including ChatGPT, Gemini, Genie[6], Shap-E[7], Skybox AI, Leonardo AI[8], Adobe Firefly[9], Runway[10], Blackbox AI[11], Poly[12], and ColorMagic[13], we developed the VR experience. Each tool served a specific function, enabling the creation of distinct creative content seamlessly integrated into the final environment. Subsequently, the created multimedia assets were integrated into the Unity 3D development platform for Meta Quest 2, where the interactions and logic of the immersive experience were programmed. This stage allowed for creating an interactive and engaging virtual environment, along with plans for user testing to evaluate the usability, fluidity, and impact of the immersive experience from development to launch. The Fig. 6 presents user interaction with elements of the *"Coffee Masterclass"* immersive experience on Meta Quest 2.

Figure 6: Screenshots of the *"Coffee Masterclass"* immersive experience running on Meta Quest 2.

3.3.3 Key findings

"Coffee Masterclass" reveals a promising perspective regarding the potential of GenAI to create engaging experiences in VR. Developing this immersive experience, *"Coffee Masterclass"* has demonstrated how the integration of *"prompt engineering"*, GenAI tools and the Unity 3D platform can lead to an immersive experience that expands the possibilities for co-creation in developing immersive systems. Similarly, it highlights the effectiveness of GenAI in generating immersive content. Also, it points to the opening of new avenues to explore its application in the creation of immersive experiences in various fields of knowledge. The successful integration of these technologies in *"Coffee Masterclass"* highlights GenAI's potential to drive innovation in the design and development of VR systems. This approach, integrates collaboration and creativity, offers a transformative way to create and experience immersive content.

Appendix A.2 provides more details of the experience development process.

[6]Genie, Luma AI, Inc., `https://lumalabs.ai/genie`
[7]Shap-E, OpenAI, `https://github.com/openai/shap-e`
[8]Leonardo AI, Leonardo Interactive Pty Ltd, `https://leonardo.ai`
[9]Adobe Firefly, Adobe, Inc., `https://adobe.com/products/firefly.html`
[10]Runway, Runway AI, Inc., `https://runwayml.com`
[11]Blackbox, Blackbox AI, Inc., `https://blackbox.ai`
[12]Poly, Poly Corporation, `https://withpoly.com`
[13]ColorMagic, Nucumo, `https://openai.com/dall-e-2`

3.4 General Recommendation

The use of GenAI tools becomes increasingly relevant across various fields. To maximize the potential of these tools and ensure optimal outcomes, it is essential to follow a set of general recommendations, providing a framework for designing and implementing *"prompt engineering"* strategies, thereby promoting effectiveness and consistency in interacting with GenAI tools.

In the design of *"prompt"* inputs, there are normally two components: instruction and context. The instruction, as the first part of the *"prompt"*, offers detailed instructions on the task for models. In the context, which acts as the second part of the *"prompt"*, provides the necessary information for models to produce quality outputs.

In this way, LLMs understand the purpose of the interaction and the nature of the expected output in the generation model. Furthermore, it is important to select keywords and phrases that guide models towards generating the outputs. To enhance understanding, related input data concerning the task at hand can be provided, encompassing input and output information, for data transformation across content, such as text, images, videos, audio, code, or 3D models, previously to the desired output. Additionally, linking the outputs and inputs of various GenAI tools can help generate visual and narrative coherence in the multimedia application currently under development. Another good practice is to utilize the outputs of these tools as inputs for the content creation team.

The collaboration between GenAI and other technologies in the creation of video games and the generation of immersive experiences in virtual reality drives innovation in the design and development of immersive systems. Additionally, GenAI's ability to automate repetitive tasks frees up time for exploring new possibilities in creating visually appealing, creative, and high-quality content, as well as crafting engaging experiences across various fields of knowledge.

The most suitable way to incorporate *"prompt engineering"* into the development of interactive multimedia applications is to consider GenAI tools as part of the development team, adopting a co-creation approach, entailing that the human team critically evaluates the outputs of these tools with the same rigor and scrutiny as they would with any team member, without mindlessly relying on their outputs, whether textual or multimedia. Therefore, we believe that the best way to integrate *"prompt engineering"* into development methods is not by changing the methodology but rather by using a development methodology that has proven effective with a human team and including GenAI tools as part of those methods, identifying where their potential is most suitable and where they can contribute to the team's work.

Iteration and supervision in content generation with GenAI tools is a fundamental process for achieving the desired output. This practice involves continuous review and refinement of *"prompts"* and input data to guide the model toward producing more accurate results. As outputs are generated, assessing their quality and coherence concerning the initial goal, context, and visual style is important. If the output does not meet expectations, adjustments can be made to *"prompts"* or input data and the generation process can be rerun. This iterative approach enables progressive improvement in result quality, ensuring the desired outcome is achieved efficiently.

4 Final remarks and Future work

This paper shows three case studies that have an initial point in the emerging trends in the field of GenAI and have allowed us to get valuable experiences that other teams in the development/production of interactive multimedia applications can replicate. It is essential to highlight that the continuous evolution of this discipline has given rise to a diverse set of possibilities and challenges, not only redefining how we conceive content creation but also establishing new paradigms in the development of interactive multimedia applications, from trends in the environment to the integration of tools in the development process.

However, it is important to accept that we are working in an emerging field, and therefore, this work cannot give definitive conclusions. The findings, final remarks and recommendations contain speculative elements that invite academic discussion to address, contrast and refute them in future works.

The presented case studies show how intervening in well-established methodologies or workflows is a reliable path to introduce GenAI tools as actors in the development/production of interactive multimedia applications. These experiences in developing virtual reality systems and video games highlights the potential of GenAI tools to generate text-to-image and text-to-3D models, reducing production times for assets and audiovisual material, which is crucial in these developments. However, maintaining consistency with the established graphic concept is necessary, as executing similar *"prompt"* inputs at different times may lead to results deviating from the intended visual concept. To counteract this problem, the outputs of these tools can be used as inputs for the content creation team, allowing them to harmonize the visual concept. This work also put light in the fact that overcoming barriers in audiovisual professionals adopting these

technologies and in perceiving them as complementary to their work rather than a threat to it, remains a primary challenge.

GenAI tools for text-to-text are a key of AI research challenge where improvements in output rigor are necessary. Despite this, they serve as a starting point for a multidisciplinary team. In the conceptualization stages, integrating GenAI tools allows for exploring additional ideas and concepts, enriching the dialogue with stakeholders. About code generation tools, an advantage is that they do not involve stakeholders in their use but provide alternatives for content creators without coding experience to explore this possibility. For those involved in coding itself, these tools provide an alternative to automate various repetitive processes. However, the chance of replicating errors in the code should be considered without proper review and testing of the outputs.

The presented experiences evidence the advantages of having a creative and development team with competencies in *"prompt engineering"* and interaction with LLMs. This finding puts in the table the discussion wetter these skills will be a desirable or mandatory in a multimedia developer team. But, a reality is that the use of GenAI tools decrease the time of multimedia production content, keeping the same quality of traditional production methods.

The multimedia assets are a value resource in multimedia development, thus a recommendation for the productive sector is to keep all GenAI outputs, as any image, model, or sound can diversify the content of the current development or future products.

However, using GenAI raises concerns about generated content's intellectual property and copyright. It is clear that determining authorship becomes complex in scenarios involving AI, needing the exploration of ways to protect copyright and intellectual property rights among developers, designers, creators, and LLMs.

Furthermore, it is important to consider how we can improve the user experience by addressing immersion, interaction, satisfaction, and user engagement concerns. Some published works have shown proposals, conducting assessments using specific metrics and implementing techniques to enhance user interfaces and visual guidelines [16, 18, 19, 36]. Additionally, it may be beneficial to consider integrating 'prompt engineering' tools into the workflow to promote efficient and collaborative design between developers and GenAI. Thus, it is important to continue research into best practices that can facilitate the development of immersive experiences across various domains.

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A Appendix

This appendix showcases a selection of the resources created using GenAI tools that are used in the development of the experiences. The aim is to demonstrate the potential of AI as a creative, complementary, and powerful tool in the design and development of attractive and immersive experiences.

A.1 Content generation in the Endless Runner experience

ChatGPT empowers video game developers to create realistic and dynamic dialogues that adapt to the player's choices and actions. This technology transforms storytelling in video games, enabling more engaging, memorable, and personalized experiences for players. The following fragment is the dialogue generated within the creation process of the narrative of the video game story.

...

Developer: *Act as a gaming expert. Perform the following task: Create the best narrative for an endless runner video game, where the main character is a space runner. Include the story summary, gameplay elements, and narrative progression. The response is intended for a game designer and developer.*

ChatGPT: *Summary of the story: In a distant future, humanity has conquered space and established colonies in various galaxies. However, a dark and mysterious force threatens to plunge the universe into chaos. A brave and determined space runner rises as the last hope to save all civilizations and restore cosmic balance. Armed with advanced technology and an unwavering will, the space runner embarks on an endless race through alien and dangerous landscapes.*

...

Skyboxes are essential elements in creating immersive virtual environments. Expansive landscapes rendered in stunning detail form the immersive sky and horizon of this virtual environment. Traditionally, skyboxes were created manually, which could be a process due to their equirectangular projection. However, GenAI tools can generate high-quality, realistic images that satisfy the projection and the environment. In Fig. 7 showcases the outputs of the skyboxes used in the video game.

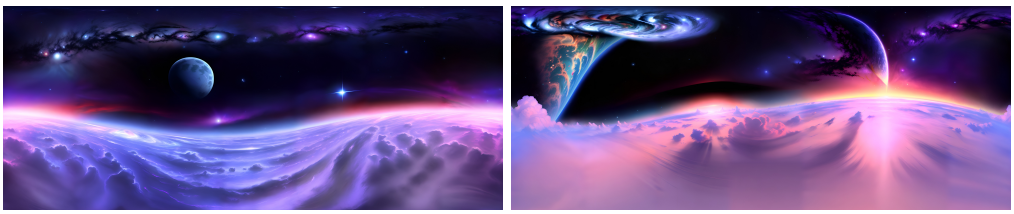

Figure 7: Output of skyboxes from *"prompt"* input text-to-image for the video game environment

A.2 Content generation in the Coffee Masterclass experience

The following dialogue shows a snippet of the interaction between different LLMs, including ChatGPT and Gemini, facilitated by cues provided by a human developer for the conceptualization of the VR experience: *"Coffee Masterclass"*.

...

Developer: *Create a creative and catchy title for the experience.*

ChatGPT: *"V60 Coffee Masterclass: Immersive yourself into the Art of Brewing".*

Developer: *Design step-by-step instructions for the V60 coffee preparation process for an immersive mixed reality experience. Include the steps, ingredients, and preparation objects.*

Gemini: *Step-by-Step Instructions for the V60 Coffee Preparation Process for an Immersive Mixed Reality Experience*

Required Objects and Ingredients:

V60 Coffee Preparation Kit: Includes a V60 dripper, paper filter, coffee server, and dripper stand. Ground Coffee: Medium grind coffee is recommended for the V60 method. Hot Water: The ideal water temperature for the V60 method is from 90 *to* 96 *degrees Celsius (from* 194 *to* 205 *degrees Fahrenheit).*

Instructions for. Preparation, Coffee Grinding, Adding Coffee, Bloom, Pouring Water, Cleanup

...

The creation of art through *"prompts"* or textual descriptions allows ideas to be transformed into images, opening a new world of creative possibilities, surreal, fantastic outputs and among other styles, capturing the essence of ideas and translate them into images with great visual quality. Fig. 8 shows some outputs generated by Leonardo AI for the experience.

Figure 8: Art output generated by Leonardo AI from *"prompt"* input text-to-image

On the other hand, GenAI tools are revolutionizing the way 3D content is created. Unlike traditional methods that require manual modeling and advanced technical skills, GenAI tools allow users to generate complex 3D models rapidly and easily, even without prior experience. The Fig. 9 shows some 3D objects generated for the experience.

Figure 9: Outputs of 3D models generated by Genie and Shap-E from *"prompt"* inputs text-to-3D

Color palettes in user interface (UI) design impact overall user perception and experience. Proper color selection can optimize readability, accessibility, and interface aesthetics. In this context, GenAI tools for creating color palettes adapt to the aesthetics and theme of the experience. Fig. 10 presents a vibrant color palette generated by ColorMagic, showcasing the tool's ability to create harmonious and visually appealing color palettes.

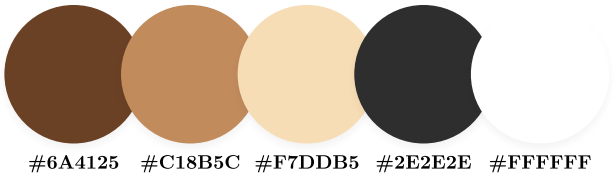

Figure 10: Color palette generated by a *"prompt"* output

Runway generated videos for the *"Coffee Masterclass"* experience. Through short prompts, videos are generated aligned with the concept of the experience, the visual concept, and the step by step of coffee preparation. Fig. 11 showcases representative samples of video frames generated in Runway.

Figure 11: Videos generated by Runway from *"prompt"* input text-to-video