

# Prototyping with Generative AI in an Extended Reality Course: From Ideation to Implementation

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**Abstract**—This paper describes an undergraduate university course on Extended Reality (XR), where students explored how generative AI could be used in developing augmented reality (AR) and virtual reality (VR) high-fidelity prototypes. Throughout the course, students used AI tools to help with tasks such as coming up with ideas, designing and developing 3D assets, writing code, and creating voice features. These tools helped students develop the prototypes faster and experiment more freely, especially for students who did not have much background in programming or prototyping. However, students faced a number of problems, such as inconsistent quality, confusing interfaces, and a growing tendency to rely too heavily on AI-based automated help. In addition, students discussed who really is the author of the AI-generated VR and AR contents, how original it is, and whether built-in biases were influencing the outcomes. The course made it clear that simply using AI is not enough. There needs to be room for reflection and awareness of its limitations. If students are going to thrive in creative fields where AI is part of the process, they will need to understand how to use it responsibly, think critically, and design with intention. Overall, the class offered an opportunity to see both the potential and the pitfalls of working alongside AI in creative education.

**Keywords**— *extended reality, virtual reality, course, generative AI, prototyping*

## I. INTRODUCTION

The integration of generative AI, a type of artificial intelligence that creates new audiovisual content, such as images, text, and audio, based on data it has been trained on [1], into creative workflows has opened new possibilities in fields ranging from video game development to other types of interactive media [2]. In the context of Extended Reality (XR), where multidisciplinary skills are required to design immersive virtual reality (VR) and augmented reality (AR) interactive experiences, generative AI offers promising support tools for

rapid prototyping [3], especially for students who may lack deep expertise in areas such as brainstorming user interface (UI) ideas, 3D modeling, texturing, or XR scripting. This paper presents our experience about integrating generative AI tools into an undergraduate XR course, highlighting how students leveraged these technologies to move more fluidly from initial concept to functioning prototype, and to support creative ways of developing them.

Throughout the course, students used a number of generative AI tools to support different phases of their XR project development. In the projects, they were required to develop low-fidelity (initial and rough versions of the finished XR product) and high-fidelity prototypes (they are almost-complete versions of the XR product). During the ideation phase, large language models (LLMs) such as ChatGPT were employed to brainstorm XR creation ideas, design interactive mechanics, and structure user flows. For asset creation, students used image-generation models in ChatGPT to produce concept art and custom textures, which they then imported into XR environments. Text-to-3D tools and procedural generation plugins further helped them create early prototypes without requiring professional-level modeling skills. In the course, LLMs and other AI tools were not the primary tools to support XR prototyping. For example, students drew low-fidelity prototypes of 3D virtual world designs by hand. AI tools were used as a complement to manual prototyping.

By lowering technical barriers and accelerating experimentation, generative AI enabled students to focus more on interaction design and user experience, which are core human-centered design goals in XR. However, the use of these AI tools also introduced new interesting challenges, including issues of authorship, over-reliance, and ethical concerns, which were discussed in class. This paper explores both the opportunities and limitations we observed when including generative AI into the XR software development process and prototyping in class. The paper also discusses reflections on

pedagogical implications on the use of LLMs in an XR development course, and propose some directions for incorporating AI-assisted prototyping more intentionally in an XR course. The integration of generative AI in an VR/AR development course is part of a XR in education framework proposed by the first two authors, striving to make the XR knowledge transfer and skills more efficiently and effectively. The central objective of this paper is to examine how generative AI tools (text-to-3D, speech synthesis, generative art, etc.) support the XR ideation and prototyping process for students.

## II. LITERATURE REVIEW

The integration of Human-Computer Interaction (HCI) principles and AI in software development has received increasing attention in HCI education and other domains such as XR, where creativity, usability, and technical complexity work together [4]. Recent work highlights the potential of AI to augment XR software development and prototyping by supporting ideation, automating repetitive (and possibly tedious) tasks, enabling non-XR expert students to engage with developing functional and usable VR/AR systems [5].

### A. AI in Software Development

AI-powered tools are advancing software engineering by assisting with code generation, debugging, and documentation, among other programming tasks. LLMs such as GitHub Copilot and ChatGPT, have been shown to accelerate programming workflows and support novice code developers through contextual code suggestions and natural language explanations [6]. However, important concerns remain regarding the accuracy of generated code and the impact of these AI tools on learning foundational programming skills overall [7].

### B. HCI and Generative AI in the Creative XR Development Process

Generative AI has been increasingly used in creative domains, including video game development and XR prototyping. Past studies have demonstrated that tools such as Stable Diffusion, and AI-based text-to-3D generation platforms, enable rapid content creation and rapid prototyping, lowering barriers for students and non-designers to prototype and visualize ideas in a short time [8]. This interesting change of paradigm using generative AI tools raises new questions for HCI research, such as how users could interact with AI-generated content and how design processes evolve when AI acts as a co-creator and become useful AI tools [9].

### C. XR Development and Education

Teaching XR development presents some challenges, as it demands skills in 3D modelling, real-time programming, UX design, prototyping, and storytelling. Pedagogical research emphasizes the need for project-based and interdisciplinary approaches in XR education [10], combining audiovisual art generation and coding, among other areas. AI tools have recently been introduced into XR labs and classrooms to support tasks such as asset generation, dialogue writing, and behavior scripting, enabling students to focus more on interaction design and user experience [11].

### D. Challenges and Ethical Considerations

While generative AI offers a number of benefits in educational settings, important challenges persist. Over-reliance on AI tools may limit students' critical thinking and design ownership, particularly among novice developers [12]. Ethical concerns, such as bias in generated outputs, transparency of AI decision-making, and questions of authorship, are central to responsible integration of AI in prototype design education [13]. These issues are especially salient in XR development, where immersive experiences can influence users' perceptions and behaviors.

This paper builds on the research outlined above by presenting findings from an undergraduate-level XR course that integrated generative AI tools into the software development and prototyping process. It explores how students used AI across ideation, prototyping, and implementation phases, and reflects on the HCI and pedagogical implications.

## III. METHODOLOGY

This study investigates how generative AI tools influence the software development process in the context of a bachelor-level XR course, with a focus on HCI-related practices and challenges. It follows a qualitative, exploratory approach, combining course design analysis, student project review, and reflective feedback to capture emerging patterns of AI integration in prototyping and development workflows.

### A. Course Context

The study was conducted within a popular undergraduate course on AR and VR application design during a regular semester, with 7 enrolled students. It was a fourth-year level special topics course that students from the Bachelor of Computer Science can take as an elective. It introduced students to immersive experience design, Unity (A popular video game engine) and its C# coding, A-Frame (a VR/AR web development framework built upon the WebVR standard, based on HTML and JavaScript coding), and prototyping techniques. The course emphasized human-centered design and encouraged iterative development cycles supported by team critique and testing. Most students had moderate to high programming experience but limited or no experience in XR development and moderate exposure to generative AI and prototyping tools.

### B. AI Tool Integration

Generative AI tools were introduced as optional aids during the ideation, prototyping, and implementation phases. Students were encouraged, but not required, to use AI tools for tasks such as:

- Ideation: Brainstorming concepts, narratives, user flows, and interaction mechanisms using language models (e.g., ChatGPT).
- Asset creation: Generating textures, UI elements, 2D/3D concept art using image generation models (e.g., ChatGPT, Stable Diffusion).

- Dialogue & Behavior Design: Crafting character dialogues or simulating NPC behavior with AI-assisted scripting or procedural content generation tools.
- Coding support: Using AI as coding assistants for Unity C# scripting, debugging, and learning API usage.

All the students used generative AI in the course. Teams of students presented their final projects in class with a reflection on tool usage, design decisions, and collaboration practices. In the final project, students had to design and develop an AR or VR simulation of an industrial process.

#### C. Hardware Used in the Course

Students used high-end gaming computers with 32 GB of RAM with Nvidia ® RTX-4080 graphics cards for developing and testing the XR environments, including the development of AI-generated assets. Students also used Meta Quest 3 ® XR headsets. Fig. 1 shows the hardware used in the XR course.

#### D. Data Collection

Three main sources of data were collected and analyzed: Documentation of design rationale, implementation details, and user testing insights from each of the final XR projects.



Fig. 1. A team of students testing a VR world in class.

#### C. E. Data Analysis

We used thematic analysis to identify recurring patterns about how students interacted with AI tools. Initial coding categories were derived from existing literature on HCI and AI in software development, including themes like co-creation, transparency, usability, trust, and automation vs. authorship. These categories were refined iteratively as new themes emerged from student reflections on the use of AI in their projects.

## IV. RESULTS

This section shows findings based on student reflections and project documentation, highlighting how generative AI

supported the prototyping process and the associated challenges and ethical considerations.

Our analysis of student projects and post-course reflections showed a number of ways in which generative AI tools supported the XR prototyping process. While students reported increased creative flexibility and faster iteration cycles, they also encountered limitations related to tool usability, content quality, and emerging ethical concerns. The findings are grouped into four main categories: AI-assisted ideation, asset creation, interaction design, challenges, and ethical considerations.

#### A. AI-Assisted Ideation and Concept Development

Students widely-used LLMs such as ChatGPT during the early stages of their projects to brainstorm storylines, user flows, and XR prototype designs. The ability to iterate quickly through different ideas was particularly valuable for teams with limited experience in narrative design or user-centered planning. Most of the teams used generative AI to generate design prompts and even character archetypes, which acted as creative springboards in the initial concept phase. However, students sometimes felt overwhelmed by the volume of suggestions made by the AI tools, and some noted that AI-generated content occasionally lacked coherence or emotional nuance.

#### B. Generating Visual Assets and Textures

Generative image models such as Stable Diffusion were used by some teams to produce textures, environmental concepts, and UI mockups. For students without prior visual design skills, these tools enabled them to quickly test ideas and visualize themes. Despite the speed and accessibility, some students noted inconsistencies in quality. AI-generated images often required manual editing to correct distortions or ensure stylistic coherence across scenes. There were also concerns about whether AI-generated visuals would align with the final project's technical requirements.

#### C. Supporting Interaction Design with AI-Driven Content

The student teams explored the creation of AI-generated dialogue and audio as possible applications into their XR experiences. LLMs were used to draft character interactions, branching narratives, and tutorial instructions. Text-to-speech (TTS) tools—often built into—were used to voice characters without the need for live voice actors. However, the quality of AI-generated speech varied, especially in terms of emotional tone and pronunciation of domain-specific vocabulary. Students expressed concerns whether the use of synthetic voices detracted from immersion.

#### D. Challenges and Ethical Considerations

While most students appreciated the speed and convenience of generative AI tools, some technical and educational and ethical challenges, and questions emerged throughout the course:

- Over-reliance and learning gaps: Some students expressed concern that relying on AI for scripting or design decisions risked undermining their understanding of fundamental development skills. To mitigate this, instructor emphasized the importance of reviewing and

understanding AI-generated code and content, and that AI should be used with moderation, and with the understanding that the AI-generated code and assets were not perfect or not always suitable for the designed VR/AR applications.

- **Authorship and originality:** Questions about creative ownership and the originality of AI-generated content were raised in some student reflections. Teams debated whether assets generated by AI could be considered "their work" and how to credit sources. This sparked productive class discussions about human-AI co-creation, authorship in digital media, and the evolving role of the developer.
- **Bias and cultural sensitivity:** A few students reported instances where AI-generated text or images reflected cultural stereotypes or historical inaccuracies. This was particularly relevant for projects involving representations of real-world people, locations, or traditions. This prompted students to critically assess outputs and incorporate more research and validation into their design process.

Overall, students reported that generative AI tools enabled faster prototyping and lowered barriers to creative expression, especially for non-technical tasks. However, these benefits came with trade-offs related to creative agency, accuracy, and ethical responsibility, highlighting the importance of integrating AI literacy and critical reflection into XR education.

## V. SUGGESTIONS FOR INTEGRATING GENERATIVE AI

The following are practical suggestions for integrating AI tools and LLMs into a higher-education XR course, aimed at enhancing creativity, reducing technical barriers, and promoting critical thinking. These suggestions are based on observed student behaviors, educational best practices cited in the Literature Review, and common HCI/AI challenges experienced in the AR/VR development course:

1. **Introduce AI tools as co-creation partners early in the course:** Explain to the students that generative AI is not a shortcut. Rather, it can work as a collaborative design assistant. Host an early workshop or give a lecture on prompt engineering, creative constraints, and critical evaluation of outputs. You should also emphasize AI's role in exploration, not automation, especially in the ideation phase of the XR development process.
2. **Incorporate structured assignments using AI tools:** Include small and focused assignments where students use LLMs to generate visual assets, such as textures and icons. Prototype simple 3D assets using text-to-3D tools such as Spline AI or Meshy. Follow up with short reflection prompts on how the AI influenced their thinking or design process.
3. **Encourage transparent documentation of AI Use:** Ask students to document when and how AI tools were used in their XR development process: What prompts were used? What was

edited, kept, or discarded? What human decisions shaped and adapted the results? You as an instructor should treat this as part of the learning outcome (e.g., understanding the affordances, capabilities, and limitations of generative AI).

### 4. Use AI as a scaffolding tool for learning AR/VR Coding

Encourage students to use LLM tools for developing code templates, syntax help and API explanation, as well as code debugging guidance. Students should conduct code refactoring by themselves if necessary, to allow them to learn more about optimizing the code. Pair this with peer-review sessions or code walkthroughs to reinforce understanding and prevent "black box" thinking (implementing and running AI-generated code without analyzing and revising its code).

### 5. Integrate AI ethics and bias reflection into the curriculum.

Dedicate a class session or module to discuss AI bias in generated content (e.g., cultural, gender, or visual stereotypes). Also, allow students to evaluate the risks of AI hallucination or misinformation in XR contexts. In addition, students must explore authorship, ownership, and creative attribution when using AI tools. Have students reflect on these topics in design journals or presentations.

### 6. Support multimodal prototype creation (text, audio, visual, code)

Provide access to effective generative AI tools that let students experiment with different modalities: Text: ChatGPT, Notion AI for ideation and documentation. Visuals: Stable Diffusion, Photoshop AI plugins. Audio: Use ElevenLabs or Play.ht to support voiceover and spoken dialogue development

### 7. Promote AI literacy through creative constraints

Use design constraints and comparisons to encourage thoughtful AI use. For example, ask students to write a short story about a virtual character's dialogue generated by an LLM, and one dialogue written by the students themselves, and let them compare both. This helps students reflect on what AI can do, and where human creativity is essential.

8. **Provide instructor oversight and feedback on AI use.** Instructors and teaching assistants (TAs) should be able to leverage AI to meet their needs in the course [14]. Review AI-generated content for quality and originality. In addition, encourage students to give formative feedback on prototype quality and AI tool selection. Students should conduct critical questioning, such as: "Is this the best design choice? Is that the best AI output?" "Do the AI-generated textures look realistic enough in the VR world?"

## VI. CONCLUSIONS

The integration of generative AI tools into an undergraduate XR course uncovered both significant opportunities and important challenges in the immersive software development process, including AR/VR prototyping. Students effectively leveraged AI for ideation, asset creation, and interaction design, benefiting from faster iteration and much greater creative freedom, particularly among those with

limited technical or artistic backgrounds. However, the use of generative AI in the XR development process showed some limitations in terms of content quality, tool usability, and the potential for over-reliance, raising critical and important questions regarding authorship, originality, and cultural sensitivity. These findings highlight the importance of including AI literacy, ethical reflection, and intentional design practices into XR education. As generative AI becomes increasingly common in creative development workflows, courses such as this offer valuable ground for exploring how human-AI collaboration can be taught, critiqued, and shaped responsibly and effectively.

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