Exploring Virtual Reality Game Development as an Interactive Art Medium: A Case Study with the Community Game Development Toolkit

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ABSTRACT

This research paper examines the development and utilization of "The Community Game Development Toolkit," a virtual reality (VR) game development tool, for the creation of interactive art experiences. The primary objective of the toolkit is to enable artist, students, researchers, and a diverse set of peoples to design story- and game-based art presentations without requiring prior game development expertise. By incorporating VR technology into the toolkit, artists are empowered to construct immersive and interactive art encounters. This study employs a case study approach to explore the potential of VR game development as an artistic medium, focusing on how artists utilize the Toolkit to construct art presentations. The research findings presented in this paper aim to contribute to the progressive field of VR art by demonstrating the diverse possibilities for accessible artistic creation in the field of VR. Ultimately, the study aims to inspire artists and researchers to delve into the artistic potential of VR game development and foster continued advancements within the field.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; • **Computing methodologies** → *Perception*.

KEYWORDS

Virtual Reality, 2D, 3D, Unity, Oculus Quest Artist, Accessibility, Ease of Access, Usability User, Immersion, Interactivity, Aesthetics, Immersive Design, Toolkit

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1 INTRODUCTION

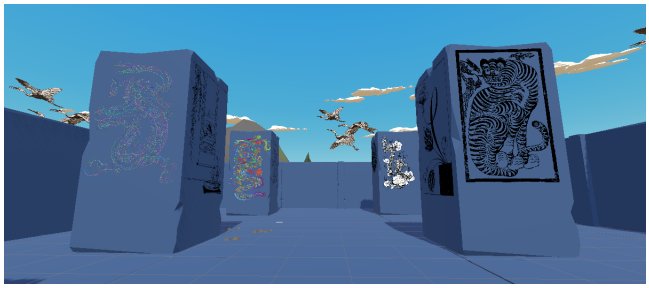

Figure 1: Sample project made with the toolkit

The utilization of VR technology offers uniquely immersive experiences and has significantly transformed various industries and creative domains. One field that stands to benefit significantly from the utilization of VR is the creation of interactive, immersive art presentations. This research paper aims to bridge this gap by introducing the development of a game design toolkit explicitly designed for making the development of artistic VR experiences accessible to wide communities of creators. The primary objective of this toolkit is to empower users from diverse backgrounds and skill levels, providing them with a streamlined approach to producing captivating and visually expressive art presentations in VR.

Furthermore, this research project includes a complementary user study, in which a group of artists will employ the toolkit to create an art presentation. Through this study, valuable insights will be gained regarding the usability, functionality, and effectiveness of the toolkit in facilitating the artistic process. The experiences and feedback shared by the participating artists will contribute to ongoing enhancements and refinements of the toolkit, ensuring its practicality and alignment with the evolving needs of artists and of the progressively evolving technology.

By developing this toolkit and conducting the accompanying study, this research aims to advance VR technology in the realm of artistic expression. It seeks to foster creativity, collaboration, and engagement among artists and audiences alike. The findings of this research will not only provide valuable insights into the development of this VR-compatible toolkit but also shed light on the potential benefits of VR in general as a medium for art presentations. Ultimately, this endeavor aspires to unlock new avenues for artistic exploration and redefine the boundaries of artistic expression in the virtual realm.

2 RELATED WORK

"The Community Game Development Toolkit" by Amelia Roth and Daniel Lichtman [3] serves as a foundational paper that directly influences the research conducted in this study. In their paper, Roth and Lichtman examined Lichtman's toolkit, aimed at assisting a diverse range of peoples in creating interactive 3D stories using accessible game development tools. The toolkit is specifically designed to cater to artists who may lack familiarity with the Unity game engine (the game engine in which the Toolkit is built), computer programming and 3D modelling. It offers a drag-and-drop approach to game design in Unity and eliminates the need for the creator to write their own code. It also includes functionality that automates the process of importing artwork, focused on using quick and exploratory 2D art-making such as drawing and photography, rather than 3D modelling. The toolkit additionally set many game engine settings automatically. Finally, the toolkit includes a comprehensive website that offers step-by-step instructions for how to use the toolkit, including how to incorporate photo spheres, images, sounds and interactivity into a project. This paper builds upon the concepts and principles presented in Roth and Lichtman's paper, and further extends the toolkit's functionality by adapting it to virtual reality environments and exploring its potential for enhancing immersive artistic expression.

A notable example of a game development toolkit that assists those will little prior knowledge of working with game engines is The Verb Collective, a toolset made by Justin Berry and Bobby Berry. In the paper "The Verb Collective." [2] the researchers present a toolset designed for students and artists. The authors describe their innovative toolkit, which enables users to create interactivity using pre-coded action-based game components, which they call "verbs". However, it should be noted that even with The Verb Collective toolkit, a certain level of familiarity with basic concepts of coding and interaction is required. Consequently, this particular toolkit may not cater to artists who seek a rapid and straightforward solution for developing and creating immersive and interactive presentations [2]. Furthermore, "The Verb Collective" is focused on creating complex forms of interactivity using a modular approach to game programming, whereas our toolkit is focused on visual composition and interactive scene design.

The paper titled "Promoting Student Engagement in the Design of Digital Games: The Creation of Games Using a Toolkit to Game Design" [1], describes a toolkit developed by Gamers4Change comprising nature-themed cards, a Rapid Game Design Document, and supplementary resources. This toolkit is aimed at supporting the creation of mobile games with nature-based themes. Feedback from students who utilized the toolkit generally indicated a positive impact, with the majority acknowledging that its use was beneficial in their game design learning process. However, it is important to note that the aforementioned examples do not directly address the challenge of developing a toolkit specifically tailored for the creation of art presentations in VR. Recognizing the scarcity of existing tools in this area, this research paper will also focuses on the development of a unique VR toolkit dedicated to facilitating the creation of art presentations. The aim is to address the existing gap by providing artists and creators with accessible tools and resources that cater to the unique requirements of VR-based art presentations.

3 METHODOLOGY

This research employed a mixed-methods approach, combining qualitative and quantitative methods to address the research objectives. The study consisted of two main components: the development of the toolkit for VR compatibility and evaluation of the VR-compatible toolkit for art presentations.

3.1 Development of the VR-Compatible Toolkit

A collaborative design process was undertaken to conceptualize and develop the VR-compatible toolkit for art presentations. The design considerations focused on usability, functionality, and integration with existing VR platforms. The toolkit was built using Unity 3D, a popular game development engine, and incorporated features such as custom settings, automated processing of imported 2D images, a pre-built locomotion system, and intuitive controls for composing visual scenes. A group of artists who were beginners in the field of VR art were invited to participate in the evaluation of the toolkit. Their feedback and suggestions were gathered through interviews and surveys to assess the toolkit's usability, functionality, and effectiveness for enhancing artistic expression.

3.2

By employing this methodology, the research aimed to develop a user-friendly VR-compatible toolkit for art presentations and compare the user experiences between the VR and 2D screen formats. The combination of qualitative and quantitative methods facilitated a comprehensive understanding of the toolkit's effectiveness and its potential impact on enhancing the artistic experience for both creators and viewers.

4 TOOLKIT DEVELOPMENT FOR VR COMPATIBILITY

The developers chose to adapt the Toolkit for use with the Meta Oculus Quest 2 headset based on its popularity and relative affordability. Adapting the original toolkit for VR compatibility required a series of modifications and additions to ensure smooth integration with the Oculus headset. The primary objective was to streamline the user experience and provide artists with an accessible means to create immersive and interactive art in virtual reality. This section presents the key developments implemented to achieve VR compatibility and enhance user accessibility.

4.1 Plugins and Settings

To ensure compatibility with VR projects, several plugins and settings were configured within the project. The XR Plugin Management and XR Interaction Toolkit plugins were installed to leverage Unity's built-in VR tools. Additionally, the plugin provider was specifically set to Oculus as the target platform, aligning the project with the Oculus hardware and software ecosystem. By installing these plugins and specifying the platform, the project seamlessly integrated with the Oculus headset. In the future, the developers hope to automate the process of installing and configuring the necessary plugins for using VR in the Unity environment.

4.2 Drag-and-Drop Locomotion System

A crucial element of VR experiences is locomotion, allowing users to navigate virtual environments. To simplify this process, a drag-and-drop locomotion system was developed as a prefab within the toolkit – a pre-configured component that creators can use in their projects. Artists can effortlessly incorporate this prefab into their VR projects by simply dragging it into the scene. The locomotion system provides intuitive controls and functionality, eliminating the need for artists to manually script locomotion behaviors. Users can seamlessly move around and explore the art presentations with their VR headsets during development and runtime.

4.3 Expanded Website Guidance

Recognizing the unique demands of VR development, an expanded section was added to the toolkit's website. This dedicated section offers comprehensive step-by-step instructions specifically tailored to utilizing the toolkit for VR projects, with a focus on the Oculus headset. Artists can access detailed tutorials, walkthroughs, and documentation that guide them through the setup and configuration process. Topics covered include initial Unity setup, proper VR settings configuration, XR plugin installation, toolkit integration, and creating projects using the included assets within the toolkit.

By incorporating Oculus headset compatibility, developing a drag-and-drop locomotion system, and expanding the website guidance, the toolkit was successfully adapted for VR environments. These enhancements aim to simplify the VR development process, reduce technical obstacles, and ultimately make the creative exploration of VR development accessible to artists, students and members of diverse communities who might not otherwise have the technical experience to work in this medium.

5 USER STUDY

The user study was conducted to evaluate the developed toolkit, with a specific focus on its VR component. The main objective of the study was to gather feedback from artists new to Unity and VR, contributing to the ongoing development and enhancement of the toolkit.

5.1 Study Design

The study design involved having artists with little to no experience in Unity and VR utilize the toolkit to create a simple project. Participants were instructed to follow the step-by-step instructions provided on the toolkit website, which included all the necessary information such as downloading Unity for the first time, importing the toolkit, creating a scene with locomotion, and exporting the project for viewing on a VR headset.

5.2 Participants

A small group of three artists participated in the study. All participants were newcomers to Unity and VR but had beginner to intermediate proficiency in art. They were college students aged between 20 and 30 and demonstrated reasonable technological literacy.

5.3 Data Collection Methods

Data collection involved administering a post-project survey to the participants. The survey encompassed a range of data collection methods, including rating scales, multiple-choice questions with text feedback options, and open-ended questions. This comprehensive approach aimed to gather feedback on various aspects of the participants' experience using the toolkit.

The rating scales provided participants with the opportunity to rate their level of satisfaction on a 1-5 scale for different aspects of the process. These scales allowed for quantitative assessment and comparison of satisfaction levels across different dimensions.

Multiple-choice questions provided participants with predefined response options, offering a structured format for collecting feedback on specific aspects of the toolkit. These questions allowed participants to provide more nuanced feedback by selecting appropriate response options.

Additionally, open-ended questions were included to encourage participants to provide more detailed and subjective feedback on their experience. Participants were given the freedom to express their thoughts, suggestions, and any challenges encountered during the project using their own words.

5.4 Study Procedures

The study was conducted remotely, allowing participants to engage asynchronously online. Participants were provided with a brief introduction to the study, its objectives, and their role in the evaluation. They were then guided through the process of using the toolkit through by the step-by-step instructions on the toolkit website. Researchers were available to answer any questions or provide clarifications if needed.

5.5 Ethical Considerations

Ethical guidelines were strictly adhered to throughout the study. Participants were provided with comprehensive information about the purpose and procedures of the study. Informed consent was obtained from each participant, ensuring they voluntarily agreed to participate. Anonymity and data protection were maintained by assigning unique identifiers to each participant's responses.

5.6 Limitations

A notable limitation of the study was the small sample size, consisting of only three participants. As a result, the data collected may reflect a more personalized perspective, and generalizability to a larger population may be limited. A larger sample size would have provided a broader range of insights and perspectives on the toolkit's usability and effectiveness.

Despite these limitations, the user study provided valuable feedback from artists new to Unity and VR. The findings from the study served as a foundation for further refinement and improvement the toolkit, enhancing its usability and addressing the specific needs of users in the artistic community.

6 RESULTS AND ANALYSIS

The Results and Analysis section presents the findings from the user study, analyzing the data collected and providing insights into the users' experiences with the VR toolkit. The table below summarizes

the quantitative responses from each user, followed by a detailed analysis of each user's feedback and a comparison between them.

Table 1: User Study Results

Users:	User 1	User 2	User 3
Level of Unity Experience	Beginner	Beginner	Intermediate
Level of VR Experience	Beginner	Beginner	Beginner
VR toolkit was easy to use	4	4	4
Clear instructions	5	5	4
Navigation was intuitive	5	3	4
Interactions felt natural	5	3	4
Toolkit is user-friendly	5	4	4

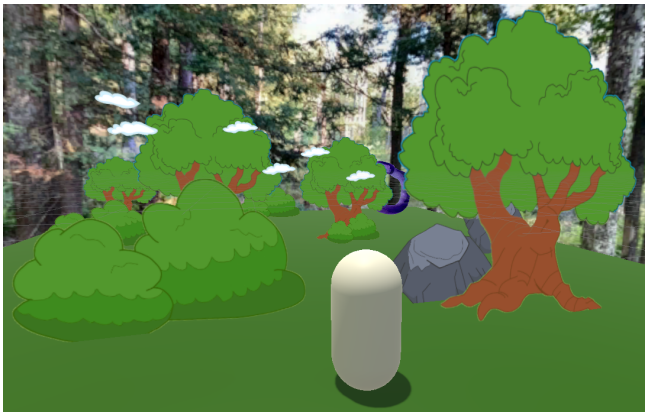

Figure 2: Screenshot of one of the user's projects (The Capsule is part of the locomotion system).

6.1 User 1

User 1 had a beginner level of experience with both Unity and VR. They found the VR toolkit easy to use, rating it a 4 out of 5. They also appreciated the clear instructions provided via the toolkit website, rating it a 5. Navigating within the VR environment and interacting with objects and tools felt natural to them, receiving a rating of 5. Overall, User 1 found the toolkit to be highly user-friendly. However, they encountered some difficulties fully setting up the VR aspect of the toolkit, which limited their ability to achieve the desired results.

6.2 User 2

Similar to User 1, User 2 had a beginner level of experience with both Unity and VR. They also rated the VR toolkit as easy to use, with a score of 4. User 2 highlighted the toolkit's strength in enabling the creation of interactive narrative games and multimedia galleries. However, they mentioned that they experienced occasional lag while using the toolkit, which may have affected the overall experience. User 2 suggested feature that they would like to be implemented was for a system in which 2D images could be mapped directly onto 3D models.

6.3 User 3

User 3 had an intermediate level of Unity experience and a beginner level of VR experience. They rated the VR toolkit as easy to use, with a score of 4. User 3 appreciated the seamless integration of the toolkit with the VR platform. They also found the toolkit user-friendly overall, with a rating of 4. User 3 did not encounter any compatibility issues or technical bugs while using the toolkit. Similarly to User 2, User 3 suggested integrating a way to morph 2D artwork, such as pixel art, onto a 3D model, and the availability of switching between player controllers for rapid prototyping.

6.4 Analysis

The data from the user study indicates that all three users, despite varying levels of experience, found the VR toolkit to be generally easy to use and user-friendly. The toolkit's clear instructions and guidance via the website were well-received by all users, contributing to their positive experience. However, some limitations were encountered, such as challenges in fully setting up the VR aspect and occasional lag reported by User 2.

Comparing the users' feedback, it is evident that User 1 and User 2 encountered similar challenges related to VR setup (due to the lack of an available headset) and performance, while User 3 had a more seamless experience. User 2's and 3's suggestion for the toolkit to integrate 2D artwork with 3D models highlights the desire for expanded features to increase the possibilities for visual design and scene creation. Additionally, User 2 and User 3 mentioned the potential for more types of pre-built interactivity for the creation of narrative-based and "choose your own adventure"-style games, and the ability to switch between player controllers as areas for further development.

Despite the limitations of this small user study, these findings provide valuable insights into the strengths and possible areas for improvement of the VR toolkit. The feedback collected will contribute to ongoing development efforts, addressing technical issues, enhancing performance, and incorporating new features to meet the needs of a diverse user base.

7 DISCUSSION

To begin with, all three users, despite their varying levels of experience in Unity and VR, found the VR toolkit to be easy to use and user-friendly. The positive ratings for the toolkit's ease of use and the clear instructions provided on the toolkit website indicate that it successfully achieved its objective of enabling artists with limited game development expertise to create captivating art presentations. This suggests that the toolkit's streamlined approach and accessible features were effective in lowering the barrier to entry for VR art creation.

However, it is important to acknowledge the limitations encountered by the users. User 2 experienced occasional lag, potentially attributable to the toolkit or Unity itself. It is also evident that User 1 and User 2 encountered similar challenges related to VR setup due to not having access to a headset. This suggests that the availability of a VR headset would have facilitated a more comprehensive evaluation of the toolkit's VR capabilities. User 3, on the other hand, had a seamless experience with no reported compatibility issues

or technical bugs, indicating successful integration with the VR platform.

The users' suggestions for additional features provide valuable insights for future development of the VR toolkit. User 2 and User 3 expressed the desire for a tool that better integrates 2D artwork with 3D object models, which would enhance the creation of scenes with depth and visual richness. Additionally, User 2 and User 3 highlighted the potential for additional types of interactivity for creating narrative games and the ability to switch between player controllers as areas for further development. These suggestions align with the growing demand for interactive storytelling and rapid prototyping in the VR art community.

It is important to acknowledge the limitations of this study, particularly the small sample size of three participants. The personalized nature of the data limits the generalizability of the findings. A larger and more diverse sample would provide a broader range of insights and perspectives, enhancing the validity and reliability and general applicability of the study's conclusions.

8 CONCLUSION

In conclusion, this research project aimed to explore the potential of VR game development as an interactive art medium by developing and evaluating "The Community Game Development Toolkit" for VR art presentations. The development process involved adapting the toolkit for VR compatibility, incorporating plugins and settings, creating a drag-and-drop locomotion system, and expanding the website guidance.

The user study provided valuable insights into the experiences of artists new to Unity and VR. The participants found the VR toolkit easy to use and user-friendly, with clear instructions and guidance. However, limitations such as access to VR headsets and occasional performance issues were identified. The feedback and suggestions from the participants will contribute to ongoing refinements and enhancements of the toolkit.

Overall, this research project contributes to the progressive field of VR art by demonstrating the possibilities for artistic creation in the VR medium. The developed VR toolkit and the insights gained from the user study aim to inspire artists and researchers to explore the artistic potential of VR game development and foster continued advancements within the field. By addressing the identified limitations and incorporating user feedback, the toolkit can further empower artists to create immersive and interactive art experiences in virtual reality.

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