RealTimeQAQCTools

Development of Real-Time QA/QC Tools for AEC in Unity

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ABSTRACT

Here, we are focusing on how our real-time visualizations are being used to improve the QA/QC process. While the AEC industry has utilized 3D CAD design software for years, the review process still typically involves commenting on printed 2D drawings or PDFs. We have developed a QA/QC tool that allows our engineers and project managers to review designs in real-time 3D, placing comment markers in 3D space for others to see. Built in Unity, this tool supports viewing and commenting on everything from individual CAD models and components to sprawling miles-long infrastructure projects, with all markup data being stored securely in the cloud for easy access to authorized contributors.

This is opposed to the traditional method, which involved building a 3D environment, rendering a video, sending it out for review, then having the review team take screenshots and compile it in a PDF. By allowing reviewers to mark up the 3D environment directly, we are drastically speeding up the iteration process. In addition, users have better insight into the current status of revisions as markups can be configured to different stages of completion as updates are made and the project evolves. We have also added multi-user capabilities – using game engine networking functionality allows for multiple users to be in the tool at once, interacting and communicating within the same environment together in real-time. And our tool is able to be built for multiple platforms, so users can access and interact with it using web, mobile devices, VR, etc. As a result, not only does using a real-time game engine speed up the QA/QC process, it also opens new opportunities for improved communication and collaboration.

CCS CONCEPTS

• **General and reference** → Cross-computing tools and techniques; Design; • **Applied computing** → Physical sciences and engineering; Engineering; Computer-aided design; • **Social and professional topics** → Professional topics; Management of computing and information systems; System management; Quality assurance; • **Human-centered computing** → Human computer interaction (HCI); Interactive systems and tools; User interface toolkits.

SIGGRAPH Talks '24, July 27–August 01, 2024, Denver, CO, USA

ACM ISBN 979-8-4007-0515-1/24/07
https://doi.org/10.1145/3641233.3664728

KEYWORDS

Unity, engineering, real-time rendering, QA, QC, quality assurance, quality control, visualization

ACM Reference Format:
Philip Luhn, Adam Liss, and David Willard. 2024. RealTimeQAQCTools: Development of Real-Time QA/QC Tools for AEC in Unity. In *Special Interest Group on Computer Graphics and Interactive Techniques Conference Talks (SIGGRAPH Talks '24), July 27–August 01, 2024, Denver, CO, USA.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3641233.3664728

1 INTRODUCTION

Quality Assurance/Quality Control (QA/QC) tools are instrumental in the Architecture, Engineering, and Construction (AEC) industry, providing a systematic approach to ensure the quality of products and services. For a leading infrastructure solutions firm like HNTB, these tools offer numerous benefits. They enhance project efficiency, minimize errors, and ensure adherence to industry standards and regulations. By streamlining workflows and facilitating effective communication among project teams, QA/QC tools can significantly improve project outcomes, reduce costs, and increase overall client satisfaction.

In the current AEC landscape, traditional QA/QC methods often involve time-consuming manual checks of 2D printed drawings or digital PDFs, which can lead to delays and increased costs. The advent of real-time 3D QA/QC tools marks a significant advancement in this area. These tools allow for immediate identification and rectification of issues, thereby reducing the likelihood of costly rework. For HNTB, the use of a custom-built real-time 3D QA/QC tool authored in Unity is leading to more efficient project execution, improved accuracy, and enhanced client satisfaction. It represents a forward-thinking approach to quality control, aligning with the company's commitment to innovation and excellence.

2 DESIGN

Our team began by moving the visualization process from black box software like Twinmotion to the Unity gaming engine. This gave us the freedom to combine engineering models with other visual elements like cars, pedestrians, and 3D buildings and terrain provided by Cesium. With this we were able to create interactive flythroughs; however, to gather feedback we still had to render out videos and still images and send them out for feedback. To allow for more accurate and immediate feedback, we began development of a custom QA/QC tool built on top of Unity which we named Q3D.

Q3D was designed with two primary goals in mind. First, it offers intuitive 3D comment and markup tools that allow users to easily annotate and highlight areas of interest or concern directly within

the 3D environment. This feature enhances communication and collaboration among project teams, leading to a more efficient issue creation, tracking & resolution workflow. Secondly, the tool provides a secure cloud-based QA/QC environment, ensuring all issues are collected, centrally located, tracked, and readily available to both the review team, as well as our visual artists who perform the needed revisions. This facilitates seamless collaboration amongst all stakeholders involved in the design, review, and production of our media deliverables.

Q3D offers a range of features that enhance the user experience and facilitate efficient quality control:

1. Playback Controls and Presets: These features allow users to control the camera within the 3D environment. Users can play, pause, fast-forward, or rewind the camera along preset paths, providing a dynamic way to inspect the environment. Since many visualization deliverables are presented as pre-rendered videos, this allows users to see exactly what the end product will look like without spending time rendering and allows them to focus their comments only on areas that will be seen in the final deliverable.
2. Complete Freedom of 3D Navigation: This feature provides users with the ability to navigate within the 3D environment freely. Users can zoom in/out, pan, and rotate the view, allowing them to inspect the models and environment from all angles and perspectives. This allows us to deliver visualizations that are not just static visuals, but also immersive, interactive tools that can be presented to stakeholders and the general public to get an even better understanding of what a project will look like when it's built.
3. Text Comments: Users can add text comments directly into the 3D environment. This feature is particularly useful for noting observations, concerns, or suggestions related to specific parts of the model, and allows us to identify where revisions are to be made. It also allows other reviewers to see comments already added, thus eliminating the need to duplicate comments across the review team.
4. Distance Measurement Tool: This tool allows users to measure the distance between two points in the 3D space, which is useful for checking dimensions and verifying the accuracy of the models.
5. Square Footage/Acreage Measurement Tool: This tool enables users to measure the area of a particular section of the 3D model, which is useful for calculating square footage or acreage, which can be critical for space planning and resource estimation.

These features collectively enhance the functionality of the QA/QC tool, making it a powerful asset for HNTB in ensuring the quality and accuracy of their AEC projects.

3 IMPLEMENTATION

- Importing the Tool into the Unity Scene: Q3D is built as a Unity package, allowing it to be easily added and removed from existing Unity projects as QA/QC needs arise.
- Access and Contribution: Users with the provided credentials can access the stored markup data. This ensures that only authorized individuals can view and contribute to the project. Users can add comments, make annotations, or provide feedback directly on the 3D model. This collaborative approach facilitates effective communication and efficient project management.
- Addressing Comments: The project authors, or admins, have the authority to mark comments as addressed. This feature allows for efficient tracking of issues and ensures that all concerns are noted and resolved. Once a comment is marked as addressed, the user who made the comment originally can then verify it as complete. This verification process ensures that all parties are satisfied with the resolution.
- Security: The data is stored securely in the cloud, ensuring that it is protected from unauthorized access and data loss. The use of secure cloud storage also means that the data can be accessed from anywhere, at any time, providing flexibility and convenience for all users.

This system of secure cloud-based storage of markup data ensures a smooth workflow, facilitating effective collaboration while maintaining high standards of data security. It's an essential tool for managing and executing AEC projects efficiently and effectively.

4 PIXEL STREAMING

Pixel streaming is a significant feature that enhances the collaborative aspect of the secure cloud-based storage of markup data. Here are the benefits:

1. Accessibility: Pixel streaming allows multiple users to access the 3D environment via pixel streaming in the web browser. This means that users don't need to download any files or have powerful hardware to view and interact with the model. This feature significantly reduces the barriers to entry, making the project more accessible to all team members.
2. Real-Time Collaboration: With pixel streaming, multiple users can view the same 3D environment simultaneously and add their comments or feedback. This real-time collaboration ensures that all team members are on the same page, facilitating effective communication and efficient project management.
3. Ease of Use: Since no downloads or specific hardware requirements are needed, users can easily access the project from any device with an internet connection. This convenience makes it easier for team members to contribute to the project, regardless of their location or the device they are using.

5 CONCLUSION

The QA/QC tool is a testament to HNTB's unwavering commitment to quality. This tool, with its intuitive 3D comment and markup tools, not only ensures precision in annotations but also fosters clear and effective communication within the team. The secure cloud-based storage of markup data further enhances collaboration and productivity by providing easy access to all annotations. By integrating such a tool into its workflow, HNTB reaffirms its dedication to delivering high-quality outcomes in every project it undertakes.