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Web3D Publishing Tools and Techniques for Digital Heritage

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Abstract

In the rapidly evolving landscape of digital heritage, the integration of Web3D technologies offers unprecedented opportunities for the preservation and dissemination of cultural heritage assets. This tutorial aims to equip participants with essential tools and techniques for effective Web3D publishing, focusing on methodologies that enhance accessibility, interactivity, and interoperability with digital heritage content. This tutorial will provide hands-on activities and live demonstrations to attendees, delivered by multiple presenters on the topics of web-friendly 3D formats, importance of metadata and interoperability, content authoring applications, and their associated content development pipelines.

CCS Concepts

· Software and its engineering → Software organizations and properties → Contextual software domains → Virtual worlds software;

1. Introduction

In the rapidly evolving landscape of digital heritage, the integration of Web3D technologies offers unprecedented opportunities for the preservation and dissemination of cultural heritage assets. This tutorial aims to equip participants with essential tools and techniques for effective Web3D publishing, focusing on methodologies that enhance accessibility, interactivity, and interoperability with digital heritage content.

In this tutorial we present introductory and advanced applications of 3D Web technologies to students and experienced practitioners in a session that consists of multiple hands-on activity and demonstration talks. Tutorial subjects include practices, tools and workflows for authoring interactive 3D scenes in cultural heritage applications. Additionally, the tutorial addresses the importance of metadata and interoperability in curating digital heritage collections, ensuring that these valuable resources remain discoverable and engaging for diverse audiences.

By the end of the session, attendees will be empowered to leverage Web3D technologies to bring their digital heritage projects to life, fostering a deeper connection between communities and their cultural narratives.

The session explores cutting-edge platforms and software solutions, including X3D, glTF, and WebGL, which enable the creation of immersive 3D environments. Participants will gain hands-on experience in modeling, rendering, and publishing 3D artifacts, alongside best practices for optimizing user experience across various devices. Below are some of the systems that are to be discussed during the session.

2. Authoring and Publishing Systems

The hands-on activities in this session will focus on the wide range of methods and patterns used to develop interactive 3D applications based on royalty-free and open ISO-IEC standards. While a full list of Web3D authoring and publishing systems can be found on the Web3D Consortium website [WEB25], this tutorial will focus largely on those systems that comprise the Web3D Ecosystem of standards and some of its related applications.

2.1. Extensible 3D (X3D)

This session seeks to expand on the previously presented X3D Quick Start Tutorial, where the Extensible 3D (X3D) standard has been explained to be “a high-level scene graph language and API above the graphics library” [POL20]. As with previous tutorials, this portion of the session will discuss the XML, VMRL, and JSON encodings of the X3D standard, related language bindings, and the

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paradigms of the X3D standard that allow it to be "interoperable, portable, and durable 3D graphics technology" [POL20].

2.2. Relationship Between X3D and glTF

As previously detailed by Polys in his 2019 Web3D blog post [POL19], much of this tutorial session will examine the relationship between X3D and glTF is characterized by their complementary roles in the realm of 3D graphics. X3D, along with VRML, represents the HTML of 3D, providing a high-level, declarative standard for creating interactive 3D content compatible with the World Wide Web. It offers a rich and extensible scene graph that allows developers to work with objects, appearances, lighting, animations, and interactions, making it suitable for complex scenes and long-term durability.

On the other hand, glTF (Graphics Library Transfer Format) Version 2.0, developed by the Khronos Group, is designed to be a lean and efficient transport format for delivering binary data directly to GPUs. It focuses on solving the low-level delivery problem by providing a minimal scene graph that can represent shapes, appearances, and animations without the need for extensive parsing. The glTF format includes Physically Based Rendering (PBR) for realistic lighting and material properties and is described as the JPEG of 3D due to its efficient handling of 3D model data.

While glTF excels in asset delivery and performance, X3D is better suited for composing interactive scenes and integrating higher-level logic, APIs, and services. X3D's ability to handle complex interactions, metadata, and scene linkage makes it ideal for applications requiring detailed user interactions and long-term viability. Together, X3D and glTF provide a robust framework for delivering and interacting with 3D content on the web, leveraging the strengths of both technologies.

2.3. The Blender Add-on for X3D Import/Export

The Web3D Consortium has long maintained an X3D import/export Add-on for Blender, the highly popular open-source 3D creation tool modeling, animation, rendering. Additionally, Blender exports to glTF and integrates with game engines. This tutorial will provide instructions on how the import/export features of the consortium's Blender Add-on can be best utilized developing digital heritage content within Blender, and how to incorporate glTF in a well-defined X3D workflow to ensure accurate geometry, textures, and metadata preservation. This workflow allows content developers to use X3D as a visual annotation to glTF assets, and to serve as a powerful navigation and exploration aid, while combining assets from multiple sources in a single scene.

2.4. Autodesk Maya with RawKee Python Edition

In this session, a new open-source X3D export tool for Autodesk Maya will be introduced. Known as RawKee Python Edition (RawKee PE) [BM25], this plugin is a reimaging of the previous C++ version of RawKee developed for Maya in the early 2000s. Through a demonstration presentation, instruction will be provided to participants on how to use RawKee PE to export X3D content from newer versions of Maya starting with Autodesk Maya 2025. This includes the ability to export animated, skinned 3D character/avatar content to the X3D format based on the H-Anim Specification.

RawKee PE was redesigned to align itself with established content development pipelines. This alignment was seen as key for future adoption as experienced content developers do not wish to deviate far from established pipelines as doing so has the perception of considerable investments in new training. As such, RawKee PE can be integrated into popular character creation and animation workflows that may also incorporate other 3rd party applications and plugins such as Clo 3D's Marvelous Designer and Animation Studios' Advanced Skeleton for Maya. By following the steps laid out in this demonstration, Digital Heritage content authors will be able to use RawKee to quickly leverage their existing content development pipelines to publish their content to the web.

Example demonstration content will include 3D models of La Ferrassie I Neanderthal thumb and index-finger bones originally used to analyze Neanderthal thumb functionality [NBE*03], as well as other cultural preservation and digital heritage 3D content developed by the UND Laboratory for Digital Realism in Engineering and the Applied Metaverse (UND DREAM Lab).

2.5. Conclusions

This tutorial will expose session participants the depth of the Web3D Ecosystem, and have a thorough understanding of how X3D, glTF, and WebGL can enable Digital Heritage projects in a manner that allows them to leverage existing content development pipeline while retaining the benefits of a "interoperable, portable, and durable 3D graphics" ecosystem of standards and applications.

References

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