glTF Composition and Interactivity

Dan Frith, Avataar
Gerald Guyomard, Adobe
Leonard Daly, Daly Realism
3DCommerce™ & Use Cases

Dan Frith, Avataar
Chair, 3D Commerce | Vice Chair, 3D Formats
Khronos Ecosystem Segmentation

Multiple Khronos standards are often relevant to developers with similar requirements. Khronos currently identifies six such market segments. Working Groups within a segment coordinate and cooperate to develop coherent solutions and outreach programs.
3D content is already pervasive in retail. Virtual representations of products are everywhere from ads, web on mobile & computer, Augmented Reality, Virtual Reality to Mixed Reality devices.
glTF Ecosystem
glTF Ecosystem & 3D Commerce
Industry Support glTF & 3D Commerce
Ace Hardware Teams with Epigraph for glTF-based 3D Web & AR Experiences.
Epigraph > Ace Hardware Pipeline

- CAD
- pixyz (Decimations and LOD Creation)
- blender® (Model Creation, Tweaking, Texturing and Publishing)
- glTF (KHR Draco Mesh Compression, KHR Materials Sheen)
- Epigraph (Portal, Customization and Management of 3D Experiences, 3D Doe and Variant Parsing Software, Distribution Platform)

- 3D/AR
- Product Tours
- Customizers
- Configurator Lite
- Configurator
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- **Physics, Scene Composition & Interactivity**
  - When compared to traditional 2D methods, 3D converts consumers but adding in Physics, Interaction & Multi-Sku and Scene Composition, consumers can play with e-commerce.
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- **NeRF (Neural Radiance Fields), Machine Learning & AI in 3D**
  - The use of generative AI in 3D Asset & scene creation whilst following standards.
Retailers looking to join the conversation about scaling 3D in their own eCommerce applications are invited to join the 3D Commerce Working Group at Khronos. Learn more at:

khronos.org/3dcommerce/ or email 3dcommerce-feedback@khronos.org.
Scene Interactivity

Gerald Guyomard, Adobe
Adding Interactivity to glTF

★ Interactivity brings your 3D Content to life:
  ○ content dynamically reacts to user inputs
  ○ A typical use case: Product Configurators
Adding Interactivity to glTF

glTF can embed static scenes made of multiple sorts of assets (meshes, textures, animations, sounds...) but there is no internal rules to define how the runtime should handle them.

Until now interactivity has been external to glTF, hence hardcoded into the application.

Interactive content is not portable to other applications.
Adding Interactivity to glTF

This new glTF extension:

- Provides blueprint for implementation of Interactive Assets (static geometry + behaviors)
- Empowers development of simple interactive applications (Games, Education, Design Review, e-commerce...)

KHR_interactivity
General Strategies for building Interactivity

- Write code
  - Compiled Language: C, C++, Swift...
  - Interpreted Language: Javascript, Lua, Python...
  - It requires some programming skills
  - Portability Issues

- Visual Scripting
  - Creator assembles and connects building blocks
  - Much easier to learn for non-engineers (no syntax to learn, no compilation necessary)
  - More portable (lightweight runtime, no sandboxed VM to rely on)
  - Limited set of blocks makes it more secure

```c++
#include "GameEngine.h"

class MyGame {
private:
  Object* _object;

public:
  void onKeyPress(char key) override {
    if (key == ' ') {
      while (true) /*pseudo code*/ {
        ::sleep(1);
        _object->rotateBy(30.f);
      }
    }
  }
};
```
Visual Scripting: Node Based Graph

- Comprehensive feature set (get/set variables or world state, branching flow, logic)
- Implemented by Unity (Visual Scripting), Unreal (Blueprints), Nvidia Omniverse (Action Graph), ...

★ KHR_interactivity provides specifications for Node Based Graphs:
  ○ Accessible and powerful
  ○ Extensible with future extensions
  ○ Compatible with visual editing, but visual editors are not required

Example Implementation: Unreal Editor
KHR_interactivity Principles

An interactivity Graph is a set of connected Nodes forming a Directed Acyclic Graph (no cycles)

Node characteristics:
- type defining the action (add numbers, listen to an event, branch on a condition...)
- an immutable configuration
- some input sockets (value and flow)
- some output sockets (value and flow)
Example of a glTF Interactivity Graph

- Enumerates a sequence of integers 1, 2, 3, 4, 5
- Sends custom events "odd" or "even" for every number (eg (value % 2) == 0 ?)
- Once done, after 2 seconds, sends custom event "Done"

Various categories of Node:
- lifeCycle/onStart, onTick...
- forLoop, delay, branch, while...
- modulo, equal, add, subtract...
- send, receive
Accessing the Scene Graph from the Behavior Graph

- High level actions change runtime scene state by starting / stopping animations, sounds, etc.

- Direct access to set / get runtime scene state using JSON paths
  - Set "/nodes/6/translation"
  - Set "/nodes/3/scale"

Extends the proposed *KHR-animation_pointer*’s JSON paths for interactivity
What can't you do, and why?

Considerations: Security, Portability, Ease of Implementation

Limitations:
- No dynamic allocation (no object instantiation, no array variables, no dynamic strings)
- No network access
- No file system access
- No multi user
Scene Composition

Leonard Daly, Daly Realism
Origination of Idea

- Adobe came to 3D Formats with a description of Composition & Interactivity at the same time as 3D Commerce was beginning to formulate use cases for the same
- Separate development with knowledge of the others work
- Combined efforts this spring with 3D Commerce taking the lead on Composition and 3D Formats for Interactivity
Types of Composition

- Level of detail
  - Distance based [traditional]
  - Time based [items that do not need to be visible throughout experience]
  - Environment based
- Streaming [large model progressive loading]
- Smart Loading [based on user device & network]
- Change (add/delete) objects in scene
LOD - Geospatial

Tree arrangement of data to support scene detail at varying distance and allow ease of navigation while streaming important data
LOD: Building Information Modeling

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Medelfast
Work to Date

- Work done in May 2023 as Prototype
- Basic test of current specification
- Note name change to “gltf Composition”
- Video of Demo
Plans and Next Steps

- **Specification development**
  - Interactivity - already described & in progress
  - Composition - work just starting
  - All in public GitHub

- **Prototype development**
  - Use case & Specification development by 3D Commerce
  - Technical development by 3D Formats
  - Prototype development by UX3D by extending Sample Viewer
Discussion and Futures

Leonard Daly, Daly Realism
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Guidelines, Tips and Tricks

• Layouts
  - Every slide should use one of the eight available layouts (see layout button)
  - Click Reset early and often to make sure you are using the layout!
  - Don’t delete slides in this template until you have used all the layouts you need
    - PowerPoint RANDOMLY deletes unused layouts (use two indents sparingly)

• Text
  - Use Trebuchet font for ALL text
  - Don’t insert empty lines within layout text boxes

• Graphics
  - Do not use shading or shadows on graphics
  - Try to connect your lines to boxes to make editing easier

• Animations and Transitions
  - Don’t forget to check them before presenting! Don’t use transitions on Zoom

• Don’t create boring slides with just text (like this one!)
  - Use more pictures and less text to get your message across
Use this blank layout when your slide content is self explanatory and you don’t need a title

This is the default standalone text box style

Add a background and/or outline using ‘Format Shape’
Automatically fit the text to the outline box using Autofit
If a box with no text mysteriously won’t change size - turn off Autofit!
Alternative to Right-aligned Bullets

Brief overview of Khronos compute acceleration standards
And why they might be of interest to the RISC-V Community

Deeper dive into OpenCL
Including roadmap developments

Discussion on how Khronos and RISC-V could collaborate
Khronos is open to any organization - please get directly involved if you wish!
We welcome feedback and cooperation between organizations

These slides will be available online
www.khronos.org
Smaller Font Bullets Make Space for Graphics

- Explicit control for acquisition and presentation of images
  - Designed to fit the Vulkan API and today’s compositing window systems
  - Cleanly separates device creation from window system
- Platform provides an array of persistent presentable images = Vulkan Swapchain
  - Device exposes which queues support presentation
  - Application explicitly controls which image to render and present
- Standardized extensions - unified API for multiple window systems
  - Works across Android, Mir, Windows (Vista and up), Wayland and X (with DRI3)
  - Platforms can extend functionality, define custom WSI stack, or have no display at all
Medium Bullets

• Broad commercial uptake of OpenCL
  - Imaging, video, vision, simulation
  - Adobe, Apple, SONY, Corel, ArcSoft
  - Dassault, Houdini, Mathematica, MAYA...

• “OpenCL” on Sourceforge, Github, Google Code, Bitbucket finds over 2,000 projects
  - OpenCL implementations - Beignet, pocl
  - VLC, X264, FFMPEG, Handbrake
  - GIMP, ImageMagick, IrfanView
  - Hadoop, Memcached
  - WinZip, Crypto++ Etc. Etc.

• Desktop benchmarks use OpenCL
  - PCMark 8 – video chat and edit
  - Basemark CL, CompuBench Desktop

https://www.khronos.org/opencl/resources/opencl-applications-using-opencl
Short Bullets

- To accompany larger graphics
Dual Column Bullets

• Extensible modular architecture encourages many fine-grained layers - new layers can be added easily

• Khronos encouraging open community of tools e.g. shader debugging

• Valve, LunarG, Codeplay and others are already driving the development of open source Vulkan tools

• Customized interactive debugging and validation layers will be available together with first drivers

• Prototype Vulkan Debugger from Valve and LunarG

  LunarG.com/Vulkan
Typical Diagram Using Title Only Layout

API Working Groups
(Industry and Academic members)

Conformance Tests and Adopters Program
Royalty-Free Specifications
Documentation, Tools, SDKs, Code Samples,
Educator Guidelines Courseware Materials

Members
Wider Community

Adopters
Build conformant implementation and products

Developers
Develop applications using the APIs

Educators / Certifiers
Create Courses
Training and Certification

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