Museum Alive with David Attenborough: The Challenges of Real-Time

Techniques for converting high quality television ready assets for the real-time mobile AR app Museum Alive with David Attenborough

Bhaumik Patel
Creative Technologist, Alchemy Immersive
bhaumikp@alchemyimmersive.com

Iona Mcewan
Creative, Alchemy Immersive
ionam@alchemyimmersive.com

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1 INTRODUCTION

Museum Alive with David Attenborough is a unique example of media convergence between broadcasting, real-time game design and VFX. The project team created a pipeline that leveraged Maya, Unity's latest AR foundation and Apple iOS hardware. We aimed to design a way of converting 3D 4K TV assets created in Maya into real-time ready assets for a high-quality mobile gaming experience.

1.1 Application overview

Museum Alive with David Attenborough is an immersive educational experience that brings users into the strange ancient worlds of long-lost prehistoric creatures through AR. Currently supported on iOS 14 and iOS 14 from iPhone 7 upwards, the app is designed to be an engaging experience for the whole family and accessible to users with little to no experience with AR.

Open Museum Alive to discover three fossils; Smilodon, Dimorphodon, and Opabinia. Each creature can be experienced in an AR diorama scene. Three information points are available to read more about each creature. The packs are populated with television content from across David Attenborough's career. The app harnesses assets created for these programs. To allow these quality assets to run smoothly on mobile devices the team had to significantly reduce their size and complexity.

While we aspire to device agnosticism, we developed the initial app for iOS for achievability. For accessibility we aimed for iPhone 7 upwards. We used Unity's AR Foundation for development to facilitate porting the experience later down the line. As an educationally enriching experience, it was also important to also develop for tablet and iPad experience, for use in educational experiences. As a mobile device experience, memory and downloadable package size were very important considerations, to avoid losing audience interest with poor performance.

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1.2 Technology stack

To create the experience, we primarily used Unity, Maya, and Quixel Megascans in combination. Developing the app inside the game engine Unity allowed us to harness features like Timeline and Cinemachine. These features provided us with a nonlinear editor interface, which we could use to plot out our animation in time then align music and other assets to them. We also created custom shaders using the shader graph, Unity's visual shader creation network.

Maya was our digital content creation tool for producing polygons, animating, retargeting characters, and baking lighting. The high-polygon assets were simplified using Maya, then placed inside Unity's real-time environment. Using Maya to create and convert these assets allowed us to preserve their quality.

To create realistic photogrammetry environments, Quixel Megascans was an important tool. Not only are the assets they provide high-quality, but they can easily and effectively be integrated into Unity through the Bridge application by Quixel.

2 CONVERTING ASSETS TO REAL-TIME

Museum Alive's hero characters were all converted from high-quality television assets. These television programs were produced at 4K 3D stereoscopic. While we wanted to preserve the high quality of the assets, their size needed to be reduced for use in a real-time game engine. To maximise the performance of an AR scene on a mobile device, we needed to reduce not only the number of textures we used but the size of those textures, as well as the bones of the assets. It was also important however to make sure that every model still looked as beautiful and alive as possible.

The original assets had been created to a high degree of scientific accuracy and signed off by experts in the fields of palaeontology and archaeology. We placed a high value on preserving as much of the accuracy in the models as possible while making sure that they were small enough for the AR experience.

We used Maya to reduce the size of the models. Smilodon was one of our most complex models. The broadcast-ready asset, had about 250,000 polygons. This model was then progressively reduced, first to 80,000 assets, and then down to approximately 10,000. To further reduce the polygon count would compromise the quality of the asset. Defining the minimum polygon count of each asset required some trial and error, but the method allowed us to preserve the scientific accuracy of the models and make them usable inside Unity.

The polygons and bones of other assets inside the dioramas also had to be simplified. We decided to prioritise the quality of our hero models over the other parts of the scene, for example, the Smilodon's prey. By carefully considered compromise, we managed to create rich scenes that helped us tell the stories of these incredible creatures.

2.1 Converting textures

Managing the textures was an important part of working with high-quality models. As with many VFX workflows, we started with complex UDIM tiles, sometimes going up to eight tiles for some of the most complex assets such as the Smilodon. Alrhough beautiful, these textures posed a major issue. In real-time, as they took up too much memory in the game engine and bloated the package size. To create a smooth experience, we had to streamline the textures.

We firstly reduced the number of tiles. Each channel, for example, colour, normal map, and roughness, would have one tile, greatly reducing the size of the textures. Each tile still contained a huge amount of detail to ensure the models appeared high-quality inside the experience, but the size was reduced for effectiveness inside Unity.

To convert these large maps, we used Nuke, a 2D compositing program. Inside this powerful program, we created a simple node structure with various transforms to convert the textures. While you could effectively reduce the maps inside a program like Photoshop, using Nuke allowed us to save time as we could program it to repeat the same transform across the different channels.

2.2 Converting rigs and animation

The most challenging part of converting broadcast assets for real-time was converting the animation rigs. The hero assets had already been animated to a high quality inside Maya using its full capabilities including bones, blend shapes, deformers and cloth simulation. Unity's capabilities are very different; your primary type of deformation tools are bones and blend shapes. While cloth simulation is also possible, it poses a drain on the scene which has a negative impact on overall performance.

An added challenge was that some of the assets were skeletons rather than skinned creatures, so we had to transfer the animation onto the skinned model as well as simplifying the animation. For the Smilodon model, we started with 300 bones. This was reduced to 60 bones in the simplified animation model.

The higher the bone count, the more calculations to be done for the vertices of the model. Each vertex on the creature was influenced by a certain number of bones. While most games would reduce the number of bones to around two, we pushed this to four on complex creatures like the Smilodon to get soft defamation on the body.

Unlike traditional animation pipelines, game-engines don't have constraints on hierarchies. This created broken hierarchies when transferring the animation, for example a disconnected leg and spine posed a major issue. While it is possible to bake the animation out to keyframes, this poses issues later if we need to change any aspect of the animation. Therefore we found the best method was to create everything as one larger hierarchy.

The retargeting of the animation from one model to the other had to be done by hand. While Maya has a biped tool, HumanIK, there is no tool for quadrupeds. While we used scripts to simplify the workflow, most of the work was done by manually matching the bones, then matching the rotation with minor adjustments to account for differences.

Another example of this methodology was on Dimorphodon's wing. The original wing was deformed using a NURBS surface; the surface was wrapped to the model, deforming it. The cloth simulation was then added to create the effect of the wing reacting to the wind. This workflow was not possible in Unity, so we had to bake these simulations into the bones of Dimorphodon, then transfer them into Unity. This made it possible to accurately fold the Dimorphodon's wing inside the game engine.

3 REAL-TIME AND AR

By carefully managing the conversion and compression of high-quality 4K models into game-engine ready assets, we managed to create rich and engaging dioramas that could be played on mobile devices.

Managing real-time performance in AR scenes is challenging on mobile devices. The amount of processing power required by the mobile device to track points in space and triangulate the position of the scene seamlessly, so it doesn't shift around on the table, is enormous. To create a seamless experience, it was important to consider every way we could simplify assets while preserving their quality.

Features in Unity like AR foundation, Timeline and Cinemachine allowed our teams to push the boundaries of core narrative and immersive AR story-telling, rather than having to develop AR technology stacks from scratch to support our project. We believe Museum Alive is a showcase of the potential of immersive storytelling and technology within education.

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