An Open Standards Based Framework For Mixed Reality Applications

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ABSTRACT
Our real world is digitizing, therefore, creating the growing need to have information stored in ways that a variety of applications can access and visualize this data. There are numerous solutions for web based applications, virtual reality, and augmented reality, but rarely do implemented solutions allow for the interoperability of 3D assets nor for the utilization of existing technological standards. Assets get trapped in platforms and walled gardens restricting the reuse of clients’ previous investments which make the development costs higher for these implementers; thus making applications cost prohibitive and retarding various industries’ growth, especially considering the current economy. This paper will identify an open standards based approach for storing and delivering 2D/3D assets for mixed reality web applications.

1. INTRODUCTION
Mixed reality (MR) refers to the merging of real and virtual worlds to produce new environments and visualisations where physical and digital objects co-exist and interact in real time. A mix of reality, augmented reality, augmented virtuality, and virtual reality. Virtual Reality (VR) has been a medium for creating interactive digital environments for decades. These real world or fantasy based environments are created for simulation, training, gaming, and a variety of other uses. Augmented Reality (AR), another decades old technology, overlays digital information to the real world, usually in the form of visual augmentation. These applications in the past have been very expensive to develop, deploy, and are often unable to communicate with other systems.

Presently, there are ever evolving web technology standards that allow for 2D and 3D data to be shared across platforms, applications, and devices. Desktop and mobile virtual environments and augmented reality applications utilize mutual databases of information, geo-located or other. Normally, when these applications are implemented to provide a service, they are often unable to communicate with each other in real-time to provide a ‘mixed’ reality experience or utilize existing customer’s assets fluidly.

The costs of developing applications are lowering as more tools are being released to allow creatives, as well as programmers, to build these experiences. The proliferation of smart phones and other mobile computing devices has brought the ability for mixed reality applications to exist in the pockets of users all around the world.

Even with these advancements, there are still major challenges for wide spread industrial adoption. Implementers need to understand the best approach for storing information for reuse; and they need the knowledge for leveraging existing standards in multiple solutions that work across desktop and mobile platforms.

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2. The Digital Environment

There are growing numbers of industries that utilizes 3D models. Real world products and buildings are usually designed in 3D CAD programs. 3D terrain and city models are created through a variety of techniques, such as, photogrammetry, LIDAR, IFSAR, and land surveying. Although, the number of ways to create 3D models is growing, the need to 'create once to use many' has pushed various industries that use 3D models to adopt or create their own standards.

2.1 Creating the 3D Models

The most widely supported 3D open standard is VRML (Virtual Reality Modeling Language). VRML is a file format for describing interactive 3D models. The VRML ‘97 standard is still supported by 3D modeling tools and applications across many industries as an interchange format.

The COLLADA (COLLAborative Design Activity) open standard is another interchange file format used for 3D assets growing in tool adoption. Storing models in these standards allows the 3D models to have interoperability between creation tools and this framework’s web applications.

2.2 Web Delivery with Interaction

For delivery of 3D models on the web in an interactive real-time environment the current standard is X3D (eXtensible 3D). Developed by the Web3D Consortium, X3D is a XML based royalty-free open standard file format for defining and communicating real-time, interactive 3D content for visual effects and behavioral modeling. The architecture of X3D allows for layered profiles and components.

- **Interchange** is the basic profile for communicating between applications. It supports geometry, texturing, basic lighting, and animation. There is no run time model for rendering, making it very easy to use and integrate into any application.
- **Interactive** enables basic interaction with a 3D environment by adding various sensor nodes for user navigation and interaction (e.g., PlanarSensor, TouchSensor, etc.), enhanced timing, and additional lighting (Spotlight, PointLight).
- **Immersive** enables full 3D graphics and interaction, including audio support, collision, fog, and scripting.
- **Full** includes all defined nodes including NURBS, H-Anim (avatar animation) and GeoSpatial components

To content developers the extensibility manifests at several levels starting with the Profile and Component statements. The Profile statement is required in every X3D document. This statement declares the maximum complexity of the world that is used by this file and all files it causes to be loaded. The Component statement allows specification of the individual pieces of functionality. Members of the Web3D Consortium have already proposed a X3D graphics profile for mobile, HTML5, and augmented reality applications.

X3D is the optimal choice for a standards based framework as it is complimentary to both VRML its predecessor and COLLADA standards. COLLADA can provide the content required for compelling X3D applications, in much the same way that it can carry and process the content for game applications.
X3D is a lingua franca for delivering interactive 3D Web and enterprise applications that require real-time delivery of 3D data, ranging from online advertising and gaming, to virtual worlds and social networks, GIS and mapping, CAD, military simulation and medical visualization.

2.3 Location

Every location in our real world holds a certain level of 2D and 3D information. This geolocated information known as Points Of Interests (POI) is essential in mirror world and location based mobile applications. The geospatial component of X3D allows for 3D objects and digital terrain models to be placed in relation to a real world location within an interactive scenegraph. The X3D Earth project is a standards-based 3D visualization infrastructure for visualizing all manner of real-world objects and information constructs in a geospatial context on a tiling globe.

Keyhole Markup Language (KML) is a widely supported XML schema for expressing geographic data within 2D maps, 3D globes, and augmented reality applications. Developed originally for Keyhole Earth Viewer, now Google Earth, KML was adopted as an Open Geospatial Consortium open standard in 2008. KML files are complimentary to X3D as a number of X3D viewers can visualize KML files and there are format convertors for .kml to .x3d.

CityGML, another standard of the Open Geospatial Consortium, is an open data model and XML-based format for the storage and exchange of virtual 3D city models. CityGML should be considered a rich source format from which X3D can easily be derived. Its main purpose is to transport geoinformation (i.e. semantic geo-objects with spatial and non-spatial properties and their interrelationships) between different datastores. CityGML is not optimized with respect to efficient visualization. However, the semantic information given by the explicit assignment of CityGML objects to thematic classes like buildings, doors, plants, and the provision of thematic attributes can be exploited to filter objects and to create X3D shapes, appearance properties and materials accordingly.

2.4 Viewing

Using X3D when developing interactive environments helps keep the content viewer independent. There are a variety of open source viewers available such as Flux, Java based Xj3D, and FreeX3D. Also, there is a range of proprietary viewers having support for more features beyond the current X3D specification such as extensions for haptic devices and augmented reality.

In current development by members of the Web3D Consortium, X3Dom strives to fulfill the current HTML5 specification for declarative 3D content and allows including X3D elements as part of any HTML5 DOM tree. X3Dom allows virtual and augmented reality applications to run natively in WebGL supported browser with no need for plugin or viewer download. Truly the capabilities of mixed reality will be ubiquitous as the major web browsers continue to support these evolving web standards.

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3. Conclusion
There are still cultural and technological challenges that need to be addressed before open standards based frameworks for mixed reality applications become ubiquitous. Industries that create and utilize 3D models need to contribute to existing 3D standards for interchange and web instead of inventing their own. Developers, tool vendors, virtual world platforms, augmented reality providers, and web3D players need to continue their support for open standards. In parallel owners of content need to understand why open standards based frameworks for their 2D/3D data are important. Industry implementations that highlight this approach will act as examples where support for open standards added value in having assets better prepared for industry service providers, mobile web delivery, integration into existing systems, and more. Create once, reuse many.

The intent of this paper is to provide an overview of an open standards based production pipeline and framework that a variety of vendor and end user applications can utilize and act upon as a call for action to implementers of mixed reality technologies for supporting existing standards. The virtual world industry did not implement existing standards and adopters of that technology suffered as assets and applications where lost as platforms closed. We now have the opportunity to take a proactive approach and learn from that example. For the web to evolve into an open platform best suited for a variety of mixed reality applications that touch into most, if not all, industries, an open standards based approach is the only option.

About the Author
Damon Hernandez works in many areas of the Web3D Industry and has been active in virtual environments and the 3D web for almost ten years. In the past, he has worked with 3D web and virtual world companies and is currently working withIDEA builder, a company that uses mixed reality technologies and robotic manufacturing to build homes more efficiently. He is acting director and liaison of a student initiated organization with the Web3D Consortium, where he also works with the Consortium’s global outreach and education initiatives.

Damon is actively involved with the 3D web’s convergence with other technologies including GIS, CAD/BIM/CAM, AR, mobile and advises a variety of entities that use these technologies. He has built numerous mixed reality applications and has lead dozens of research projects in multiple domains. As one of the founding members of the now international Augmented Reality Developer Camp, he is actively working to help grow the AR developer community.

References
3 Brutzman, D., Behr, J., “Proposed X3D Graphics profile for mobile, HTML5 and augmented reality (AR) applications” Powerpoint presentation to ISO, June 2010
4 Arnaud, R., Parisi, T., Developing Web Applications with COLLADA and X3D March 25, 2007
5 Kolbe,T., “OGC CityGML and W3DS” Powerpoint presentation for X3D Earth Working Group Meeting, November 2007

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