Introduction to mago3D – A Web Based Open Source GeoBIM Platform

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1. Introduction

Although there have been numerous attempts to integrate BIM and 3D GIS on a single geospatial platform, the outcome of those attempts are not so satisfactory till to date. Difference of data model, massive number of data to be rendered, big volume of file size are among those major technical barriers that hindered seamless integration of BIM and 3D GIS. And there are many increasing demands to see and to integrate BIM and 3D GIS on a web browser since web environment has been proven as an effective collaborative platform in architecture and geospatial domains. This abstract introduces an open source based GeoBIM platform called mago3D that could manage, handle, and visualize massive 3D data from BIM, AEC, 3D GIS and others simultaneously on a web browser. mago3D platform has been developed on top of well-known open source GIS projects, Cesium(http://cesiumjs.org/) and NASA World Wind(https://worldwind.arc.nasa.gov/), to make the best of their existing features and to expand the functionalities to BIM and AEC(Architecture, Engineering and Construction) areas. As a result of this development, mago3D now can handle and visualize massive 3D data not only from semantic data but also from point clouds and realistic meshes.

2. Development of mago3D platform

2.1. mago3D as a JavaScript

mago3D has been designed and implemented as a JavaScript plug-in for existing WebGL Globe to expand WebGL Globe's functionality and usability to indoor space and architectural(BIM) areas. To do this, mago3D.js has been designed and developed as a WebGL independent JavaScript to avoid lock-in to a specific WebGL Globe and to increase portability and expandability. mago3D.js is composed of 6 main components like follows:

a. Mago3D Connector that interacts with WebGL Globe such as Cesium, World Wind
b. Mago3D Renderer that shades and renders 3D data
c. Mago3D Accelerator that enhances performance such as frustum & occlusion culling, indexing, and LOD(Level Of Detail) handing
d. Mago3D Data Container that contains and manages 3D data
e. Mago3D Process Manager that manages whole process from data receiving to rendering
f. Mago3D REST API that provides API for 3D data sending and receiving

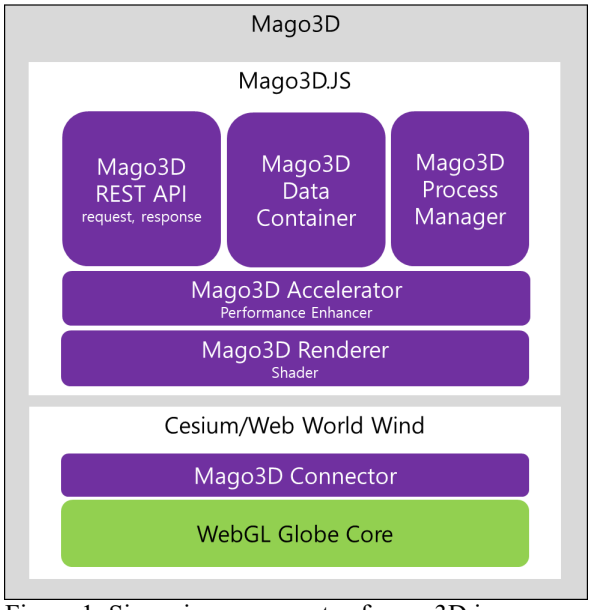

Figure 1: Six main components of mago3D.js

By plug in mago3D.js to Cesium, World Wind, or other WebGL Globe, users can expand those WebGL Globe's functionalities and usability to

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BIM and indoor space without losing the default functions of WebGL Globe's.

2.2. Devising a New Format

One of big hurdle to integrate BIM and 3D GIS simultaneously is handling and visualization of massive 3D data. The file size of 3D surface model converted from parametric BIM model is usually very large. And converted 3D surface model has a tendency to contain many duplicated objects and meshes since those objects are from mainly man-made ones. It is very hard to visualize those large size 3D surface model with WebGL Globe itself. To overcome this hurdle, new format called F4D has been devised for reducing file size and increasing rendering speed. F4D format aims at reducing file size of surface model by removing duplicated objects and recording only one object information for duplicated objects with block-reference concept. F4D format makes use of unique mesh IDs, transformation matrix, and color to reconstruct each 3D objects. Also a format converter that converts popular 3D format to F4D has been developed. Currently industry standard IFC(Industry Foundation Classes), JT(Jupiter Tessellation), and popular 3D formats such as OBJ, 3DS, COLLADA DAE can be converted to F4D format. F4D format coupled with mago3D.js has been proven that it can increase memory management efficiency and rendering speed. mago3D can visualize massive 3D data including indoor objects, at least 100k objects, in a single scene seamlessly with traditional outdoor 3D GIS objects on a web browser. Conceptual diagram of how to adopt block-reference concept is as follows:

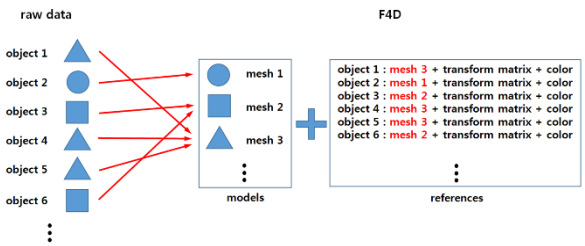

Figure 2: Conceptual Diagram of Block-Reference

F4D format is not file based but folder based one that contains several datasets. F4D format is composed of 1 header file and 3 sub folders, those are HeaderAsimetric.hed, Bricks folder, Models folder and References folder respectively. Parent's folder name of datasets is the same as that of object name in BIM or other 3D files.

2.3. Adopting Variable Depth Octree

To increase the rendering speed and to reduce network traffic, F4D adopted variable depth octree indexing methods. This indexing recursively decomposes the 3 dimensional space and removes empty space till to find so-called 'Survived' octree. The conceptual diagram of this algorithm is explained in the following figure.

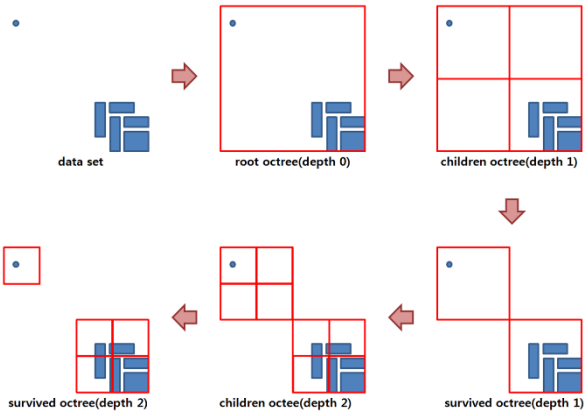

Figure 3: Conceptual Diagram of Variable Depth Octree

This kind of Octree indexing gives several benefits over conventional method. First, server can use this indexing information as an efficient data packet. Second, client can increase the rendering speed by easily determining which object should be drawn. Thirdly, network traffic can be reduced by sending/receiving the bundled Octree data.

3. Conclusions

As a result of this development, mago3D now can quickly display massive and complex 3D objects on a web browser without losing precision or accuracy. The platform also provides an integrated admin page for tasks management such as attribute handling and issue management. Also users can now examine indoor and outdoor objects at the same time on a single platform. As an open source projects all the source codes of mago3D are opened and maintained at GitHub: https://github.com/Gaia3D/mago3d .

4. References (Max 5 reference)

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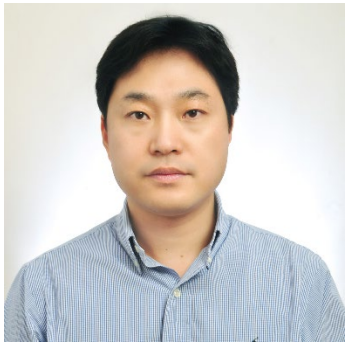
5. Author/s Biography



Short Author/s Biography (150-200 words)

Mr. Sanghee Shin is a founder and CEO of Gaia3D, Inc., an open source geospatial company in Korea. He has been involved in various open source activities around the world for more than 10 years. He established OSGeo Korean Chapter in 2008 and was elected as a Charter Member of OSGeo Foundation in 2011. He organized an international FOSS4G Seoul 2015 conference as a chair person and has served as a board member of OSGeo Foundation for 2 years. He is an active promoter of open source, open standard and open data. His major interests include 3D GIS, GeoBIM, and climate/weather technology.