Voxelizing Google Earth: A Pipeline for New Virtual Worlds

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Fig. 1. A voxelized version of city streets in Paris, France

The rapid evolution of digital mapping technologies has facilitated novel ways of visualizing and interacting with geographic data. Our project introduces a groundbreaking approach to transforming Google Earth's 3D Tiles into voxels for use in Minecraft, web browsers, and virtual reality (VR) environments. This method significantly advances the automation of Earth representation in voxel-based platforms, offering a way in which to artistically view our world.

1 METHODOLOGICAL INNOVATIONS

Voxel Earth is a novel methodology that primarily is the extraction and conversion of Google Earth's 3D Tiles into a voxel-based format. This process involves several steps, starting with the selection of 3D Tiles that represent the Earth's geography with high precision and detail. These tiles are processed through a custom-designed pipeline that decomposes each tile into a grid of voxels, with each voxel representing a specific volume of space.

The voxelization algorithm assigns color and material properties to each voxel based on the original photogrammetry data. This step is critical for ensuring that the digital representation closely matches the real-world appearance of

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geographic features. The algorithm takes into account various attributes such as color, texture, and elevation data to create a faithful voxel model of the Earth's surface.

Mapping voxels to Minecraft blocks involves an ML algorithm that considers environmental context, aiming to recreate natural and urban landscapes within the game accurately. This mapping is not merely aesthetic; it also seeks to preserve the functionality of the Minecraft environment. For example, water bodies are represented with water blocks to maintain the game's physics, and vegetation is mapped to various plant blocks to reflect different biomes accurately.

We note that the only previous work in this area is a large project called "Build the Earth", which requested the manual labor of thousands to build out their cities inside of Minecraft. By using a pipeline to convert photogrammetry to Minecraft voxels, we trim those millions of manual labor hours down significantly. We release our results as a Minecraft server, a browser-viewable map, a VR experience, and several exported Minecraft worlds at varying voxelization resolutions, as well as famous locations voxelized as art.

2 TECHNICAL CHALLENGES AND SOLUTIONS

One of the primary technical challenges we faced was the vast scale of the data involved. Google Earth's comprehensive global coverage means that converting the entire Earth into voxels requires processing enormous quantities of data. To address this challenge, we developed optimization techniques that streamline the voxelization process, such as parallel processing and data compression methods, allowing us to manage the data efficiently without sacrificing detail or accuracy. In the Minecraft server we release, we only voxelize new 3D Tiles as they load.

Another challenge was ensuring that the voxel models remain up-to-date with the constantly evolving geographic data from Google Earth. Our solution incorporates an update mechanism within the pipeline that periodically refreshes the voxel models based on the latest 3D Tiles, ensuring that changes in the physical geography are accurately reflected in the digital models.

3 APPLICATIONS AND IMPLICATIONS

The voxelized Earth project has far-reaching applications beyond gaming. In education, it provides an engaging platform for teaching geography, environmental science, and urban planning. Students can explore detailed models of geographic features, cities, and landscapes, gaining a deeper understanding of spatial relationships and environmental processes.

In urban planning and architecture, professionals can use the voxel models for simulation and visualization of urban development projects. The ability to interact with and modify realistic models of urban environments in Minecraft offers a unique tool for collaborative design and planning processes, as we believe that Minecraft blocks and architectures can be imagined back to reality with models like Stable Diffusion.

4 FUTURE DIRECTIONS

Looking forward, we aim to enhance the resolution and accuracy of the voxel models by working closer with Google's 3D Tiles. The 3D Tiles format differs significantly from the Google Earth standard, so not all of the regions available on Google Earth are yet available to 3D Tiles, limiting our world.

In conclusion, Voxel Earth represents a significant advancement in the field of digital earth representation. By automating the conversion of Google Earth's 3D Tiles into interactive voxel-based models, we provide a scalable, dynamic, and detailed method for exploring and interacting with the Earth's geography. The potential applications of this technology are vast, spanning education, urban planning, entertainment, and beyond, promising to enhance our understanding and appreciation of the planet's diverse landscapes and environments.