

**Honours Project - MHW225671**

**INTERIM REPORT**

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**Department of Computing**

**Submitted for the Degree of: Computer Games (Software Development)**

**BSc Computing**

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**Project Title:**

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**Signed by Student:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_**

Polygons are accepted as the standard geometric primitive used in 3D modelling; they are defined as any closed 2D shape made up of entirely straight lines. Current GPU manufacturers and tech giants have invested heavily into polygons, which originates back to the late 1990s with the NVIDIA GeForce 256. (TheBat!, 2023) It is assumed they were chosen as the standard due to their simplicity and efficiency within computer graphics, but also due to their ability to imitate almost any object. Their most prominent drawback is that they can only ‘*imitate*’ these objects aesthetically. In comparison, voxels or volumetric pixels are used to represent values in three-dimensional space on a regular grid. Voxels function similarly to real particles, therefore making them a more sophisticated implementation used to imitate the real world. They can be viewed as a 3D pixel and have a wide use in procedural generation, particle simulation, and destructive physics. Voxels have had a clear point of contention as the standard rendering practice and have a vast potential in the future of 3D modelling.

Since voxels hold the data of their value in three-dimensional space, they allow efficient usage of Object-Oriented Programming, (OOP) which allows each voxel to hold unique properties. In the case of the 3D voxel game ‘*MakeFarm*’ by David Szymon Grobert, it was used to define if a block is breakable, and if so, should the object then be added to the inventory. (GROBERT, 2023)

1. Introduce current ‘standard’ geometric primitive.
2. Introduce alterative of voxels and give definitions.
3. Give insight as to why voxels are not the current standard geometric primitive.
4. Suggest that voxels have been overlooked when looking at its specific use cases.

## Notes

### RSPI Project

Compare three separate models of varying complexity and compare file size of Voxels and Polygons. The voxel model is created by using the polygonal model and applying a voxelization method until all components are visible.

I found I had issues with this, specifically with, is this not inherently biased towards polygons as they are created using any technique they want, whereas voxels are limited to the voxelization algorithm.

Also, the method of ensuring models are relative in different format was to voxelize until all components are visible, which could incredibly vary depending on what the user assumes is a component. (In this case it was facial shape, arms, legs and muscle definitions)

## Voxels

Voxels take their name from Volumetric Pixels and represent a value in three-dimensional space on a grid. They are one of the many geometric primitives, and are mainly used within particle simulation, and subsequently dynamic creation and destruction. They are vastly different from the current dominant geometric primitive of polygons, as current GPU manufacturers mainly support the usage of polygons. They also lack research, as their support within the 3D computer graphics community puts them as an aesthetic, rather than a different method.

Voxels strengths lie within advanced rendering techniques much like raytracing, as with traditional rendering techniques, the conversion of the Voxel structure to polygons is required. This can be seen in the Marching Cubes Algorithm, Surface Nets, and Voxelization. Some techniques including Voxelization lose the benefits of voxel data manipulation at runtime and are mainly used for their aesthetic during