Development of a 3D Graphics Engine

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Abstract

Visualization is an extremely valuable tool in problem solving, especially as problems become more complex. The goal of this project is to create an engine to facilitate three-dimensional visualizations of problems without requiring knowledge of OpenGL. Additionally, the engine should be able to perform at a high level by giving the developer a deeper level of control. The engine architecture is designed to let the developer have as much control over the IO and rendering processes as he or she wants. Game developers will also benefit from mesh modification functions and rendering optimizations.

Procedures and Methods

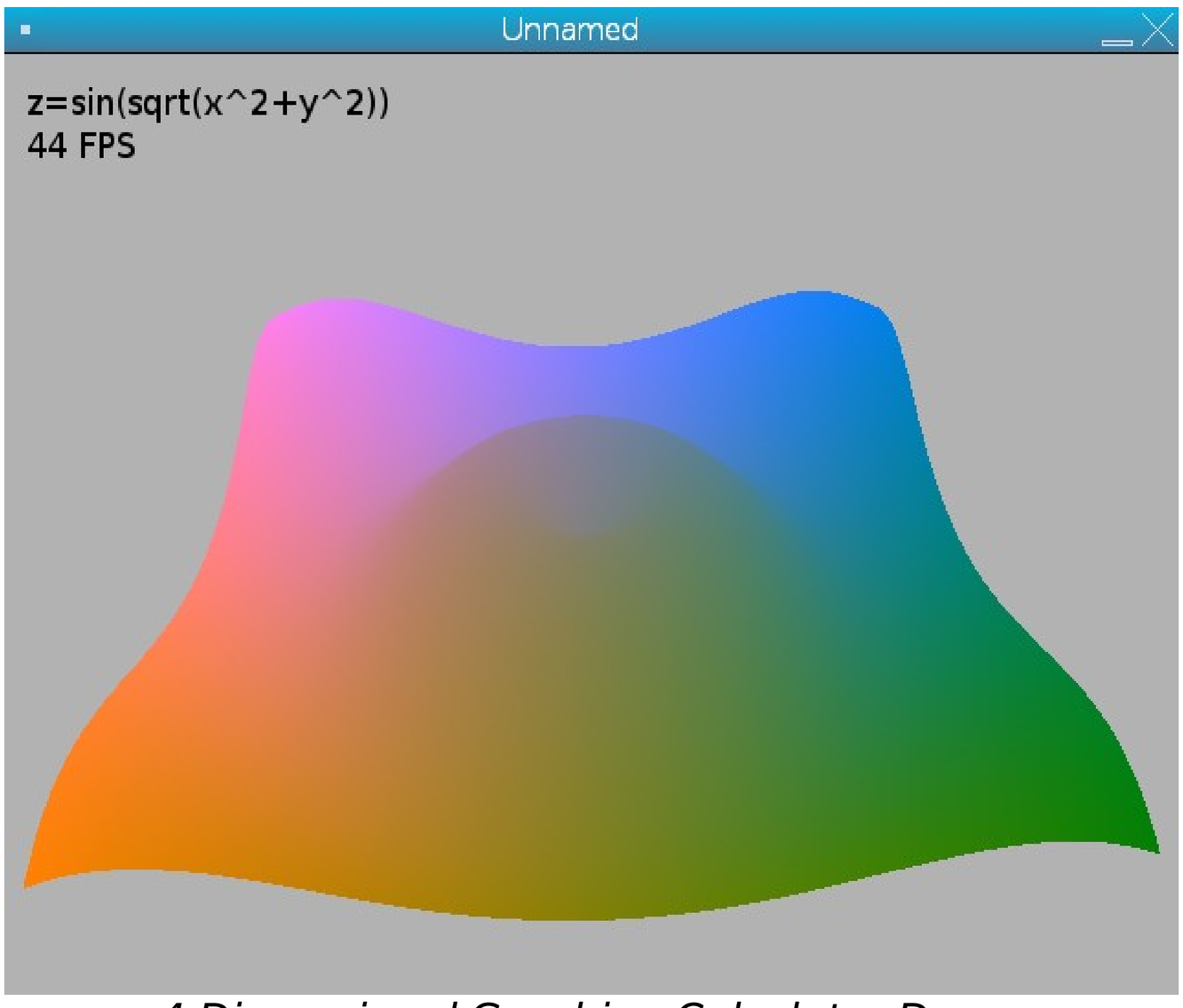
The engine is designed with speed and memory efficiency as the primary goals. Modularity is achieved by abstracting the engine from the math, mesh, and material functions.

The engine consists of a basic engine framework, and accessory methods useful for 3D graphics, such as camera management. A highly optimized mathematics library provides data structures and methods for use with vectors, quaternions, matrices, and planes.

The material methods are in a separate library, which has support for multitexturing, lighting properties, and GPU shaders, which modify the fixed rendering pipeline of the graphics hardware. The library also includes image loading routines.

The mesh functions are also exported to a separate library. Support for loading from MD2, MD3, and MD5 formats is included. Vertex and skeletal animation can both be used, and methods to read and write data in the internal format are provided.

Mesh data is stored internally in the half-edge format. This allows for easier modification of the mesh topology and adjacency queries, which are useful in collision detection. Semantic data, such as triangle vertex specifications, is separated from vector data, so that the vector data may be placed in Vertex Buffer Objects for optimized transmission to the GPU.



4 Dimensional Graphing Calculator Demo

Rendering and animating meshes in 3 formats