

CLAIMS

I claim:

1. In a computerized architectural design environment in which a design program is loaded into memory and processed at a central processing unit, a computer-implemented method for rendering a lighting effect from a light source on an object within a design space, the method comprising:

receiving from a user one or more inputs regarding a location of the object in the design space;

calculating a voxel, wherein the voxel represents at least a discrete portion of the object in the design space, and comprises an intermediate representation of the discrete portion of the object;

generating a first surface vector that extends from a first surface of the voxel and points in a first direction;

generating a second surface vector that extends from a second surface of the voxel and points in a second direction that is different than the first direction;

calculating first lighting information generated by the light source on the first surface by combining a first light source vector extending from the light source and the first surface vector, wherein the first surface vector is normal to the first surface of the voxel;

calculating second lighting information generated by the light source on the second surface by combining a second light source vector extending from the light source and the second surface vector, wherein the second surface vector is normal to the second surface of the voxel;

rendering at least the discrete portion of the object in the design space;

calculating a normal vector from a surface of the rendered discrete portion of the object;
and

rendering the lighting effect on a final representation of the discrete portion of the object by interpolating a lighting effect from the first lighting information and the second lighting information based upon a relationship between the normal vector from the surface of the rendered discrete portion of the object, the first surface vector, and the second surface vector.

2. The method as recited in claim 1, further comprising:
 - calculating a volume map for at least the object in the design space, wherein the volume map is associated with a plurality of light sources in the design space, and the volume map comprises one or more voxels that represent various portions of the design space;
 - calculating a shading effect on the voxel, wherein calculating a shading effect on the voxel comprises determining whether any of a plurality of rays extending between the voxel and each of the plurality of light sources in the design space intersects with a surface.
3. The method as recited in claim 2, wherein rendering the lighting effect on the object in the design space comprises using the shading effect, the lighting information, and the normal vector of the discrete portion of the object to interpolate the lighting effect on the object in the design space.
4. The method as recited in claim 1, further comprising:
 - associating with the discrete segments in a first volume map assigned surface vectors that point in a positive x direction;
 - associating with the discrete segments in a second volume map assigned surface vectors that point in a negative x direction;
 - associating with the discrete segments in a third volume map assigned surface vectors that point in a positive y direction;
 - associating with the discrete segments in a fourth volume map assigned surface vectors that point in a negative y direction;
 - associating with the discrete segments in a fifth volume map assigned surface vectors pointing in a positive z direction; and
 - associating with the discrete segments in a sixth volume map assigned surface vectors point in a negative z direction.

5. The method as recited in claim 4, further comprising:
calculating a plurality of volume cube maps, wherein each volume cube map comprises one or more voxels that represent various portions of the design space; and
assigning to each volume cube map a particular direction associated with the surface vector, such that all of the one or more voxels within each respective volume cube map include the surface vector associated with the same particular direction.
6. The method as recited in claim 5, wherein rendering, using the lighting information, the lighting effect on the discrete portion of the object in the design space comprises using information from only three of the calculated volume cube maps.
7. The method as recited in claim 5, wherein assigning to each volume cube map a surface vector, comprises assigning surface vectors to the plurality of volume cube maps such that the surface vectors create a basis for a vector space.
8. The method as recited in claim 1, wherein the lighting effect is re-rendered a plurality of times without re-calculating either the shading effect or the light intensity.
9. The method of claim 8, further comprising re-calculating the lighting information when the user changes the location of the object within the design space.