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REPRESENTING A THREE-DIMENSIONAL VOXEL WITH A SINGLE POINT USING BINARY STRING

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Abstract: The Present visualizes representing a three-dimensional volume element, Voxel, using a single point in a three-dimensional image. A three-dimensional Voxel, by convention, is represented using three points. The proposed work presents a method to represent the same using a single point.

I. INTRODUCTION

A volume element in a three-dimensional image is often represented using a three-dimensional Cartesian coordinate system. A Voxel, V, as shown in figure 1, is represented using, say, V(a, b, c). The three points, a, b and c represent the position of Voxel from the origin along X, Y and Z directions. The present work, not deviating the idea, presents a method to represent the Voxel using a single point say V(v). The point, 'v' is a N-bit binary string. Each of the coordinate axes is represented using bits, x.

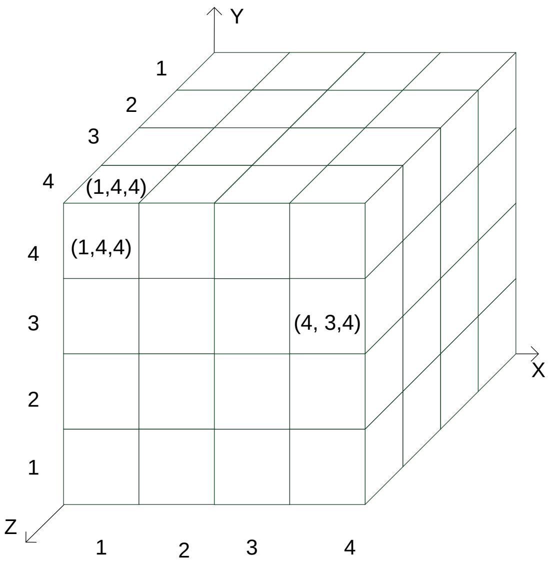

Figure 1: Voxels in Cartesian coordinate system

II. PROPOSED WORK

The number of bits, 'n' in the binary string depends on the perfect cubic number. The size of the Voxel cube depends on the combinations of binary bits taken along each of the coordinate axes. Each of the coordinate axes can take only binary values, and hence determines the size of the cube.

From binary logarithm, we have, $x = \log_2 n$

Number of steps along each of the axes = $n = 2^x$, where x = 1, 2, 3, 4…

Number of bits, N = 3x and

Number of Voxel points, V in the cube = n^3.

The steps, n, in the coordinate axes can have values in the powers of 2, such as, 2, 4, 8, 16 and so on. The bits, x, required to denote the steps in each of the axes will be 1, 2, 3, 4 and so on respectively. The number of bits, N, of the binary string representing the whole of the cube will be three times the number of bits, x, used to denote the steps in each of the axes. The size of the, Voxel, V, is given by the n^3, represented by a single point, v, denoted by a N bit binary string. The adjacent steps in each of the coordinate axes differs by one bit. This is to ensure that the whole Voxel cube stays together with a single bit difference. The arrangement of cubes for N = 3 bits is shown in figure 2. The arrangement of Voxels with their binary representation is shown in figure 2.

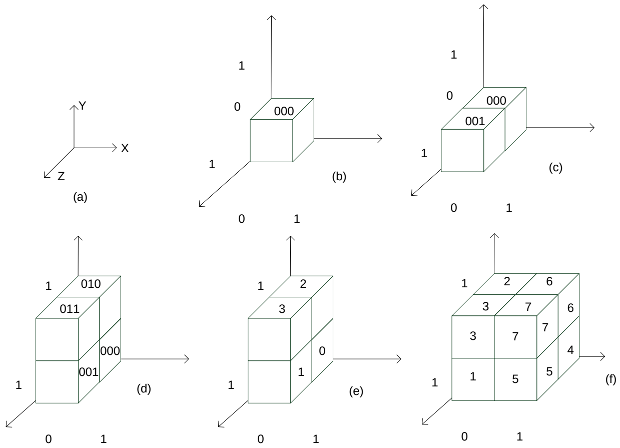

Figure 2: Voxels for N = 3 bits

Single point Representation: If there are 6 bits in the N-bit string representing v, then the first two bits represent the x axes, the next two represent the y axes and the last two represent the z axes. If N = 9, then first 3 represents the x axes, the next 3, y and the last 3, z axes. If 101101 is the string, then the position of the Voxel is V(45). Figure 3 shows the arrangement of Voxels for N = 6 bits.

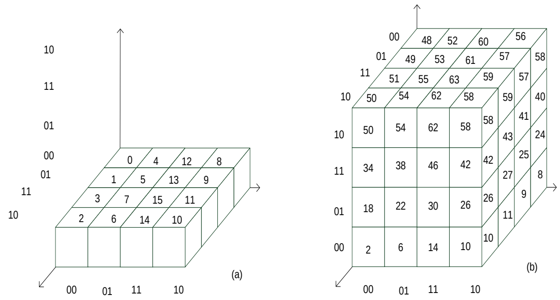

Figure 3: Voxels for N = 6 bits

III. CONCLUSION

Hence, the three-coordinate system represented by, say, V(a, b, c) is denoted by a single point V(v) where v is a N bit binary string.

