**Program 4 (3D Transformations & Perspective Projection)**

**Section 1: Program Basics**

My program takes in an input file and uses perspective projection to draw the lines from the input file in black on the screen, then my program offers the user a chance to transform the object using basic translation, basic scale, regular scale, and rotation about any of the three axis. After the user chooses their preferred transformation, the program will apply the necessary transformation matrix and use perspective projection to display the new image in blue on the same screen. Before using perspective projection to display any of the lines, the program asks the user specifics about the viewpoint, screen size, and distance from screen in order to provide an accurate image.

**Section 2: Perspective Projection**

The following table displays each of the perspective projection variables that can be changed and what the impact is for each.

|  |  |  |
| --- | --- | --- |
| Variable | Small Value | Large Value |
| View Point (x) | Value: 1  I seemed to see the cube from a higher perspective | Value: 20  I seemed to see the cube from a more sideways perspective |
| View Point (y) | Value: 1  The cube seemed smaller and thinner | Value: 20  The cube seemed longer and end up being cut off by the bottom of the screen |
| View Point (z) | Value: 1  The cube seemed longer, and I saw it from a more head on viewpoint | Value: 20  I seemed to see the cube from almost directly above it because it was small. |
| Screen Size | Value: 10  The cube was too big to be seen on the screen, it was cut off on both ends | Value: 60  The cube was really small on the screen |
| Distance from Screen | Value:20  The cube was really small on the screen | Value:100  The cube was a lot bigger on the screen |

What I found most intriguing was that when the screen size was smaller, the cube was bigger. I had expected the cube to be smaller when the screen size was smaller.

**Section 3: Proof of Transformation**

The following images display what it looks like when transforming the 3d object.

This is the original.

Chart, radar chart

Description automatically generated

This is the object after a translation by 20 in the X direction, 10 in the Y direction, and -20 in the Z direction.

Chart, radar chart

Description automatically generated

This is the object after scaling with basic scale by 3 with respect to X, 6 with respect to Y, and 2 with respect to Z.

Chart, radar chart

Description automatically generated

This is the object after rotation around the X axis by an angle of 20 degrees.

Chart, radar chart

Description automatically generated

This is the object after rotation around the Y axis by an angle of 20 degrees.

Chart, radar chart

Description automatically generated

This is the object after rotation around the Z axis by an angle of 20 degrees.

Chart, radar chart

Description automatically generated

This is the object after scaling with regular scale by 3 with respect to X, 6 with respect to Y, and 2 with respect to Z. X center at 10, Y center at 10, Z center at 10.

Chart, radar chart

Description automatically generated

**Section 4: Other shapes**

The following image is a pyramid displayed with perspective projection, proving that my program works with other types of 3d objects.

Chart

Description automatically generated