My renderer contains many key viewing parameters, including the eye position, the view direction, the up direction, and the horizontal field of view. Changing any of these parameters produces varied effects on our final rendered scene. To explain all these parameters, I’m going to start with a scene defined by the following input. It renders two spheres, a red one behind a green one (fig-1).

imsize 512 512

eye 0 0 0

viewdir 0 0 -1

hfov 45

updir 0 1 0

bkgcolor 0.2 0.2 0.2

mtlcolor 1 0 0

sphere 0 0 -8 2

mtlcolor 0 1 0

sphere -1 0 -6 1

A red and green circles

Description automatically generated

Fig-1

Let’s start with the eye position. As you move the eye in 3D space, the position that we view the spheres from changes. We can move it to view the spheres from above, below, to the right, to the left, or any combination. This will change the apparent position of the spheres, as well as altering their apparent shape slightly. Let’s try using 0.15 0.1 0 for the eye position and we’ll see the spheres move up and to the right because the eye has moved down and to the left (fig-2). If we then change the z value to 0.5 the spheres will get bigger because we’re viewing them from closer (fig-3).

A red and green circles

Description automatically generated

Fig-2

A red and green circles

Description automatically generated

Fig-3

Next let’s look at the view direction. Changing this value will change the angle at which we view the spheres changes. This will also change the apparent position of the spheres in interesting ways. If we take our base fig-1 picture and change the view direction x and y values to 0.05 and 0.1 respectively, our view angle moves up and to the right. The spheres, therefore, will appear to move down and to the left (fig-4). One thing to note is that the view direction is normalized, so above 1 the values don’t matter. If we change our z value from -1.0 to -100.0 the view will stay the exact same.

The up direction is a particularly interesting vector. Changing the values of this vector rotates the perspective to view the scene in different ways. Changing the up direction from (0 1 0) (straight up the Y axis) to (1 0 0) (straight up the X axis) rotates the scene 90 degrees and the green sphere appears on the bottom (fig-5).

Finally, let’s look at the horizontal field of view. This parameter defines how much of our scene we can view. If the field of view angle is very small, then less of our scene will be visible and our spheres will appear larger (fig-6). Conversely, if the angle is large then more of the scene will be visible and our spheres will appear smaller (fig-7).

A red and green circles

Description automatically generated

Fig-4

A red and green circle

Description automatically generated

Fig-5

A red and green circle

Description automatically generated

Fig-6

A red and green circles

Description automatically generated

Fig-7

These parameters can all be changed to change and distort the image in many ways. The scene can be distorted or changed to produce dramatic effects. If you want to disorient the viewer, for example, you might change all these parameters to rotate and move the scene around. Combining human creativity and ingenuity with these mathematical functions produces works that we can all appreciate, like movies, video games, art, visualization, computer aided design, and many other applications.