Exercise 3

Kevin Serrano, Gianni Scarnera

24 October 2012

Part 3.2 Transformation and Translation

First we have to calculate the dimension of the near plane. Given the angle in y-axis from the camera to the near plane and the distance of the near plan, we can calculate the distance of the $top, bottom, left, right$ from the center of the near plane. Then the half-height is given by trigonometric rule

Figure 1: Camera, near plane and far plane

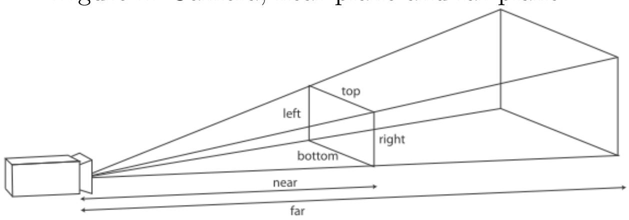
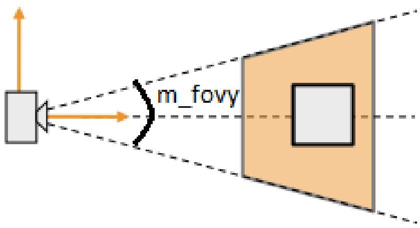


Figure 2: angle



$$halfheight = nearPlane \cdot tan(m_{fovy}/2)$$

where m_fovy is in degree. Then we can do a ration to figure out the half-width and then

$$halfwidth = halfheight \cdot Height/Width$$

where Height and Width are from the camera. Then we can juste compute the $top, bottom, left, right$ as $bottom = -halfheight; top = halfheight; left = halfwidth; right = -halfwidth;$

Then the projection matrix is given in the course and is

$$\begin{pmatrix} (2 \cdot n)/(r-l) & 0 & (r+l)/(r-l) & 0 \\ 0 & (2 \cdot n)/(t-b) & (t+b)/(t-b) & 0 \\ 0 & 0 & -(f+n)/(f-n) & -(2nf)/(f-n) \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

Then in the cube.vs file, we applied the transformation in this order to get the gl_position :

$$gl_{Position} = (ProjectionMatrix*WorldCameraTransform*ModelWorldTransform)*gl_{Vertex};$$

The translation matrix is given in the course:

$$\begin{pmatrix} 1 & 0 & 0 & t_x \\ 0 & 1 & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

so we can return this matrix in $getTranslationMatrix()$

Now the difficulty to implement the $translateWorld()$ and $translateObject()$ functions is that we have to do the multiplication in correct order, because matrices multiplication isn't ever commutative as we've seen in lecture. For $translateWorld()$, the translation must be applied after all previous matrices and it's the inverse for $translateObject()$, i.e : for $translateWorld()$

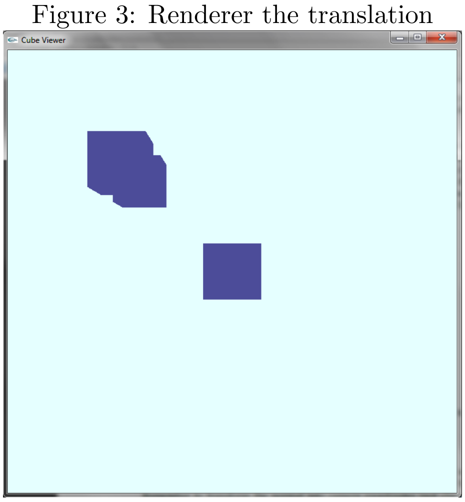
$$m\_transformationMatrix = getTranslationMatrix(\_trans) \cdot m\_transformationMatrix;$$

and for $translateObject()$

$$m\_transformationMatrix = m\_transformationMatrix \cdot getTranslationMatrix(\_trans);$$

where $m\_transformationMatrix$ is the current transformation matrix.

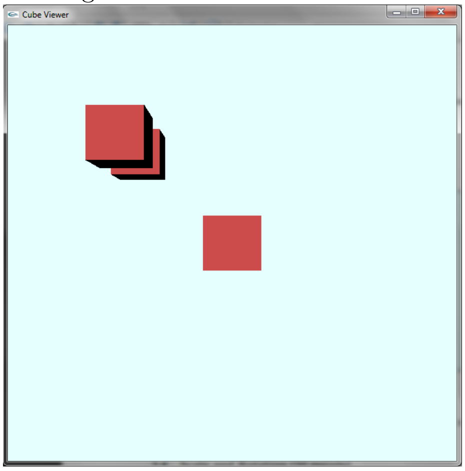
Figure 3: Renderer the translation



3.3 Shaders

In the file cube.vs, we have to give the gl_color and gl_normal on the color and normal vectors. $normal = (WorldCameraNormalTransform * ModelWorldNormalTransform) * gl\_Normal;$
$color = gl\_Color;$ and then in the cube.fs file we have to implement the diffuse shader, so we need the normal vector and the vector from point to source light (0,0,-1). Then if the dot product between these two vector are positive then we compute the $gl\_FragColor = color \cdot (N \cdot L)$, else the fragColor is black.

Figure 4: Renderer the shader



3.4 Scale and Rotation

The rotation matrix, given a angle and a axis, is given by (wikipedia)

$$\begin{pmatrix} cos(\theta)+u_x^2(1-cos(\theta)) & u_xu_y(1-cos(\theta))-u_zsin(\theta) & u_xu_z(1-cos(\theta))+u_y\sin(theta) & 0 \\ u_yu_x(1-cos(\theta))+u_zsin(\theta) & cos(\theta)+u_y^2(1-cos(\theta)) & u_yu_z(1-cos(\theta))-u_xsin(\theta) & 0 \\ u_zu_x(1-cos(\theta))-u_ysin(\theta) & u_zu_y(1-cos(\theta))+u_ysin(\theta) & cos(\theta)+u_z^2(1-cos(\theta)) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

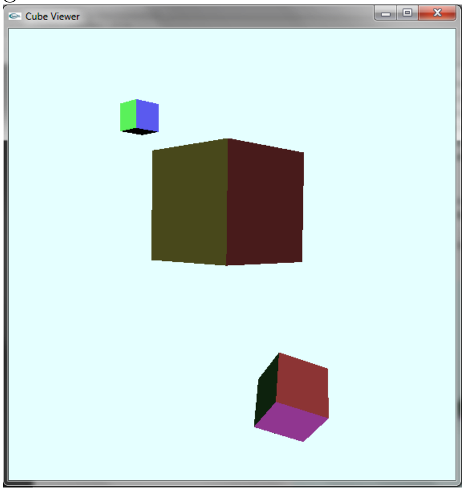
where u_x, u_y, u_z are component of the vector axis. Then $rotateWorld()$ and $rotateObject()$ are implemented in order like in part 3.2.

The scaling matrix is trivial and given in the course:

$$\begin{pmatrix} s & 0 & 0 & 0 \\ 0 & s & 0 & 0 \\ 0 & 0 & s & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

where s is the scale. Like before the function $scaleObject()$ and $scaleWorld()$ are implemented like 3.2.

Figure 5: Renderer the rotation and scaling



3.5 Clipping Planes

If we cut the cube, we will have triangles, squares, pentagon and hexagon. In this figure there are the cut we founded.

Figure 6: Shapes