CS488 Computer Graphics

Section 1 (Craig Kaplin)

Assignment 2

Submitted by:
Shawn Henderson
sbhender
00183318

Additional Documentation

1. Clipping
Z plane clipping is done just before projection, both far and near. The side line clipping is done just after projection. clipWindow() takes references to the two points that define a line to be clipped against the 4 sides of the viewing area, and returns a Boolean indicating whether the parameters are to be used (fully visible or partly clipped) or not used (completely clipped). clipPlane() is similar, except it clips against the near and far plane.

2. Matrices

- m_modelTransform --- stores the translation and rotation transformations for the model
- m_modelScale --- stores the scale transformation for the model
- m_viewTransform --- stores the translation and rotation transformations for the view plane
- m_projection --- stores the projection matrix
- m_viewport --- stores the viewport matrix

The projection matrix and viewport matrix could be created on the fly, but they were made member variables and updated only when necessary, in an attempt to create a more efficient pipeline.
The projection matrix is the fully specified matrix as described in the notes, calculated with the angle of the FOV, the aspect, and the near and far plane locations. The viewport matrix handles the stretching to meet the defined 'screen', and doing appropriate translations to map from NDC space to the viewport.

Extra Features

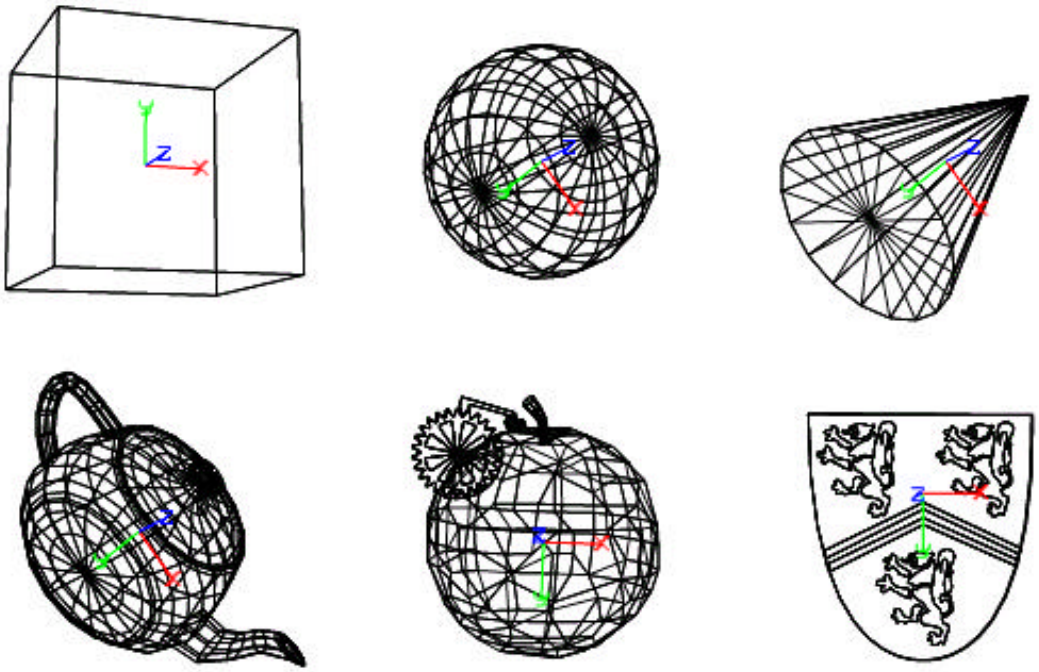
1. Gnomon alterations
The model gnomon is coloured using the three primary colours, and the world gnomon coloured using the three secondary colours. At the end of each of the gnomon axis lines, the letter indicating the axis label (x, y and z) is drawn using the font previously used for A1. The letters are drawn at the very final stage of the pipeline, so they are not subject to any of the transformations. They are manually clipped to the viewport.

2. Defining Viewport
When the Viewport option is selected from the menu, any of the three mouse buttons can be used to define the viewport. The viewport is drawn dynamically on the screen as it is being defined. The clamping does not take into account the labels at the bottom of the viewing area, and it is possible to have a viewport extending off the visible screen by enlarging the window, drawing the viewport, and shrinking the window, as the program does not attempt to prevent this.

3. Other models

From the Shapes menu, alternate models can be displayed and manipulate. The selection returns to Cube on reset, and is cube by default.

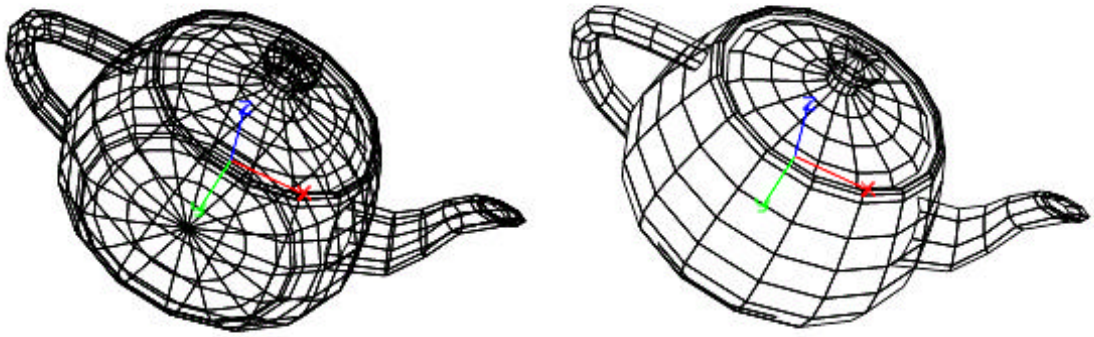
The shapes are, in order, Cube, Sphere, Cone, Teapot, Clockwork Orange, and Waterloo Crest. The Sphere, Cone and Teapot are models generated and exported by 3d Studio Max. The Clockwork Orange and Waterloo Crest were modeled by me.



4. Projection Modes

There are two projection modes available, Perspective and Orthographic. This is set to Perspective by default and on reset. Orthographic mode merely skips the application of the projection matrix. This can be selected from the View menu.

5. Backface Cull
Backface Culling removes the lines that are part of polygons that are facing away from the viewing plane, which speeds up rendering roughly by a factor of two. This is unchecked by default and on reset. It can be found under the View menu. An example of backface culling is displayed below.



The left image is generated with culling off, while the right image with culling on. Note that there is no hidden surface removal, and that some of the models were not imported with full polygon information, so the culling is occasionally erratic for those.

6. Maintain Aspect Ratio
Normally, when the viewport is defined with an aspect ratio other than 1, the image will distort. When Maintain 1:1 Aspect is unchecked in the View menu, the aspect adjustment is applied only to the viewport matrix, but not the projection matrix, resulting in the stretch. When checked, the aspects cancel to result in an aspect ratio of 1 for the image displayed in the viewport.. This option is off by default and on reset.

7. Information Labels
Two labels are used to accommodate all the information to be displayed. The first line displays the name of the shape currently selected, the current transformation mode, and the number of vertices and lines that are used in displaying the shape. The second line displays the Field of View angle in degrees, and the location of the Near and Far clipping planes.

8. Default location
By default, and on reset, the view and model are translated and rotated to interesting positions.