Window and View ports

A rectangular area specified in world coordinates is called a window.

A rectangular area on the display device to which a window is mapped is called a view port.

The window defines what is to be viewed; the view port defines where it is to be displayed.

Often windows and view ports are rectangles in standard position with rectangle edges parallel to coordinate axes

The mapping of a part of world coordinate scene to device coordinate is referred to as viewing transformation.

Window to View port Transformation (Viewing Transformation)

To transform a window to the view port we have to perform the following steps:

Step1: The object together with its window is translated until the lower left corner of the window is at the origin

Step2: The object and window are scaled until the window has the dimensions of the view port

Step3: Again translate to move the view port to its correct position on the screen

The overall transformation which performs these three steps called the viewing transformation. Let the window coordinates be (x_{wmin}, y_{wmin}) and (x_{wmax}, y_{wmax}) where as the view port coordinates be (x_{vmin}, y_{vmin}) and (x_{vmax}, y_{vmax})

Therefore the viewing transformation is as follows:

1. We have to translate the window to the origin by

   $$T_x = -x_{wmin} \text{ and } T_y = -y_{wmin}$$

2. Then scale the window such that its size is matched to the view port using

   $$S_x = (x_{vmax} - x_{vmin})/(x_{wmax} - x_{wmin}) \qquad S_y = (y_{vmax} - y_{vmin})/(y_{wmax} - y_{wmin})$$

3. Again translate it by $T_x = x_{vmin}$ and $T_y = y_{vmin}$

All these steps can be represented by the following composite transformation:

$$CM = T_W * S_{wv} * T_v$$

Where CM = Composite Transformation (here, Viewing Transformation)

T_W = Translate window to origin

T_V = Translate view port to origin to (x_{vmin}, y_{vmin})

S_{wv} = Scaling of window to view port

$$T_w = \begin{bmatrix} 1 & 0 & -x_{wmin} \\ 0 & 1 & -y_{wmin} \\ 0 & 0 & 1 \end{bmatrix} \qquad S_{wv} = \begin{bmatrix} s_x & 0 & 0 \\ 0 & s_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad T_v = \begin{bmatrix} 1 & 0 & x_{vmin} \\ 0 & 0 & y_{wmin} \\ 0 & 0 & 1 \end{bmatrix}$$

The Viewing Transformation can be shown as follow:

→ Translate → Scale → Translate →