COMPUTER GRAPHICS

SOLUTION

First we have to translate the triangle's point A(3,2) to origin since it is the point we have to fix. The matrix used there is:

$$\begin{bmatrix} 1 & 0 & x \\ 0 & 1 & y \\ 0 & 0 & 1 \end{bmatrix}$$

Where x=3 and y=2. So, the matrix becomes:

$$\begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

To perform the rotation, the matrix used is:

$$\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Where $\theta=60^{o}$. So, the matrix becomes:

$$\begin{bmatrix} 0.5 & -0.866 & 0 \\ 0.866 & 0.5 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

To translate the shape back to its original position, the matrix used is:

$$\begin{bmatrix} 1 & 0 & -x \\ 0 & 1 & -y \\ 0 & 0 & 1 \end{bmatrix}$$

Where x=3 and y=2. So, the matrix becomes:

$$\begin{bmatrix} 1 & 0 & -3 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{bmatrix}$$

Now, we find the composite matrix by multiplying the three matrices in the order of translateMatrix * rotationMatrix * translateMatrixBack:

$$\begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} . \begin{bmatrix} 0.5 & -0.866 & 0 \\ 0.866 & 0.5 & 0 \\ 0 & 0 & 1 \end{bmatrix} . \begin{bmatrix} 1 & 0 & -3 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{bmatrix}$$

=

$$\begin{bmatrix} 0.5 & -0.866 & 3.232 \\ 0.866 & 0.5 & -1.598 \\ 0 & 0 & 1 \end{bmatrix}$$

Now we find the new 2 points of the triangle. First, we multiply this composite matrix with

$$\begin{bmatrix} 6 \\ 6 \\ 1 \end{bmatrix}$$

For the point C(6,6)

$$\begin{bmatrix} 0.5 & -0.866 & 3.232 \\ 0.866 & 0.5 & -1.598 \\ 0 & 0 & 1 \end{bmatrix} . \begin{bmatrix} 6 \\ 6 \\ 1 \end{bmatrix}$$

=5.196+3-1.598

$$\begin{bmatrix} 1.036 \\ 6.598 \\ 1 \end{bmatrix}$$

Hence the new point C is: (1.036,6.598)

Then, we multiply the composite matrix with

$$\begin{bmatrix} 6 \\ 2 \\ 1 \end{bmatrix}$$

For the point B(6,2)

$$\begin{bmatrix} 0.5 & -0.866 & 3.232 \\ 0.866 & 0.5 & -1.598 \\ 0 & 0 & 1 \end{bmatrix} . \begin{bmatrix} 6 \\ 2 \\ 1 \end{bmatrix}$$

=

$$\begin{bmatrix} 4.5 \\ 4.598 \\ 1 \end{bmatrix}$$

Hence the new point B is: (4.5,4.598)

Hence the new points of the triangle are:

A(3,2**)**
B(4.5,4.598**)**
C(1.036,6.598**)**