OpenGL 3D Graphics in Liberty BASIC

Lesson Seven: Texture Mapping

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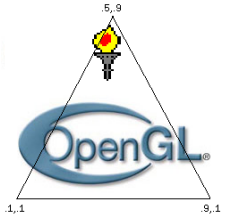
Texture mapping applies an image to a set of coordinates instead of a color. The program is setup to use 24-bit bitmaps, though other formats can be used. The bitmaps must be sized to a power of 2 in order to work properly with OpenGL, 2x2, 4x4, 8x8, 16x16, etc.... In my own experience 256x256 gives pretty good results.

In this first sample, the call to 'CreateBMPTexture' loads the bitmap and gives it the name "1". 'glEnable GL.TEXTURE.2D' tells OpenGL that we will be working with textures. And 'glBindTexture GL.TEXTURE.2D , Texture' sets texture 1 as the one we will be applying to the triangle.

In the TextureVertex calls, the first two values specify the x,y position of the bitmap to use. The remaining three are the X,Y,Z coordinates of the triangle. For the bitmap coordinates, (0,0) is the bottom left, (0,1) is the top left, (1,1) is the top right and (1,0)is the bottom right. The photo below shows the x,y bitmap coordinates used for the triangle.

```
    'triangle with partial bitmap texture
    CALL glClearColor .9 , .9 , .9 , 1
    CALL
 ClearView eyeX , eyeY , eyeZ , centerX , centerY , centerZ , upX , up
Y , upZ

    Texture = 1
    CALL CreateBMPTexture "OpenGL_Logo.bmp" , Texture
    CALL glEnable GL.TEXTURE.2D
    CALL glBindTexture GL.TEXTURE.2D , Texture

    CALL glBegin GL.TRIANGLES
      CALL TextureVertex .1 , .1 ,    -1 , -1 , 0
      CALL TextureVertex .5 , .9 ,     0 ,  1 , 0
      CALL TextureVertex .9 , .1 ,     1 , -1 , 0
    CALL glEnd

    CALL RefreshView

    CALL glDisable GL.TEXTURE.2D

    WAIT
```



These next two examples build a textured cube and a textured cylinder with the normals applied. The cylinder example shows how to apply a texture to a Quad-strip.

```
    'cube with bitmap texture
    CALL
 ClearView eyeX , eyeY , eyeZ , centerX , centerY , centerZ , upX , up
Y , upZ
    CALL glClearColor .8 , .8 , .8 , 1
    Texture = 1
    CALL CreateBMPTexture "OpenGL_Logo.bmp" , Texture
' load bitmap and put in Texture #1

    Width = 1.5
    Height = 1.5
    Depth = 1.5
    CubeCenterX = 0
    CubeCenterY = 0
    CubeCenterZ = 0
    CALL glGenLists 1
    CALL glNewList 1 , 4865
      CALL
 BuildTextureCube Width , Height , Depth , CubeCenterX , CubeCenterY ,
 CubeCenterZ , Texture
    CALL glEndList

    FOR a  = 1 TO 360
      CALL
 ClearView eyeX , eyeY , eyeZ , centerX , centerY , centerZ , upX , up
Y , upZ
      CALL glRotatef a  , 1 , 0 , 0
      'CALL glRotatef a  , 0 , 1 , 0
      CALL glRotatef a  , 0 , 0 , 1
      CALL glCallList 1

      CALL RefreshView
      CALL Pause 15
```

```
    NEXT a

    WAIT



SUB BuildTextureCube W , H , D , cX , cY , cZ , tex
    GL.QUADS=7
    GL.TEXTURE.2D = 3553

    CALL glEnable GL.TEXTURE.2D
    CALL glBindTexture GL.TEXTURE.2D , tex
    tc=1  ' change to a value greater than 1 to have the texture tiled
    'front
    CALL glBegin GL.QUADS
      CALL glNormal cX-(W/2),cY-(H/2),cZ+(D/2) , cX-(W/2),cY+(H/2)
,cZ+(D/2) , cX+(W/2),cY+(H/2),cZ+(D/2)
      CALL TextureVertex 0  , tc , cX-(W/2) , cY+(H/2) , cZ+(D/2)
      CALL TextureVertex tc , tc , cX+(W/2) , cY+(H/2) , cZ+(D/2)
      CALL TextureVertex tc , 0 , cX+(W/2) , cY-(H/2) , cZ+(D/2)
      CALL TextureVertex 0  , 0 , cX-(W/2) , cY-(H/2) , cZ+(D/2)
    CALL glEnd
    'back
    CALL glBegin GL.QUADS
      CALL glNormal cX+(W/2),cY+(H/2),cZ-(D/2) , cX-(W/2),cY+(H/2)
,cZ-(D/2) , cX-(W/2),cY-(H/2),cZ-(D/2)
      CALL TextureVertex 0  , tc , cX+(W/2) , cY+(H/2) , cZ-(D/2)
      CALL TextureVertex tc , tc , cX-(W/2) , cY+(H/2) , cZ-(D/2)
      CALL TextureVertex tc , 0 , cX-(W/2) , cY-(H/2) , cZ-(D/2)
      CALL TextureVertex 0  , 0 , cX+(W/2) , cY-(H/2) , cZ-(D/2)
    CALL glEnd
    'left
    CALL glBegin GL.QUADS
      CALL glNormal cX-(W/2),cY+(H/2),cZ-(D/2) , cX-(W/2),cY+(H/2)
,cZ+(D/2) , cX-(W/2),cY-(H/2),cZ+(D/2)
      CALL TextureVertex 0  , tc , cX-(W/2) , cY+(H/2) , cZ-(D/2)
      CALL TextureVertex tc , tc , cX-(W/2) , cY+(H/2) , cZ+(D/2)
      CALL TextureVertex tc , 0 , cX-(W/2) , cY-(H/2) , cZ+(D/2)
      CALL TextureVertex 0  , 0 , cX-(W/2) , cY-(H/2) , cZ-(D/2)
    CALL glEnd
    'right
    CALL glBegin GL.QUADS
      CALL glNormal cX+(W/2),cY+(H/2),cZ+(D/2) , cX+(W/2),cY+(H/2)
,cZ-(D/2) , cX+(W/2),cY-(H/2),cZ-(D/2)
      CALL TextureVertex 0  , tc , cX+(W/2) , cY+(H/2) , cZ+(D/2)
      CALL TextureVertex tc , tc , cX+(W/2) , cY+(H/2) , cZ-(D/2)
```

```
      CALL TextureVertex tc , 0 , cX+(W/2) , cY-(H/2) , cZ-(D/2)
      CALL TextureVertex 0  , 0 , cX+(W/2) , cY-(H/2) , cZ+(D/2)
    CALL glEnd
    'top
    CALL glBegin GL.QUADS
      CALL glNormal cX-(W/2),cY+(H/2),cZ+(D/2) , cX-(W/2),cY+(H/2)
,cZ-(D/2) , cX+(W/2),cY+(H/2),cZ-(D/2)
      CALL TextureVertex 0  , tc , cX-(W/2) , cY+(H/2) , cZ+(D/2)
      CALL TextureVertex tc , tc , cX-(W/2) , cY+(H/2) , cZ-(D/2)
      CALL TextureVertex tc , 0 , cX+(W/2) , cY+(H/2) , cZ-(D/2)
      CALL TextureVertex 0  , 0 , cX+(W/2) , cY+(H/2) , cZ+(D/2)
    CALL glEnd
    'bottom
    CALL glBegin GL.QUADS
      CALL glNormal cX-(W/2),cY-(H/2),cZ+(D/2) , cX+(W/2),cY-(H/2)
,cZ+(D/2) , cX+(W/2),cY-(H/2),cZ-(D/2)
      CALL TextureVertex 0  , tc , cX-(W/2) , cY-(H/2) , cZ+(D/2)
      CALL TextureVertex tc , tc , cX+(W/2) , cY-(H/2) , cZ+(D/2)
      CALL TextureVertex tc , 0 , cX+(W/2) , cY-(H/2) , cZ-(D/2)
      CALL TextureVertex 0  , 0 , cX-(W/2) , cY-(H/2) , cZ-(D/2)
    CALL glEnd
    CALL glDisable GL.TEXTURE.2D

END SUB



    ' build a textured cylinder
    CALL
 ClearView eyeX , eyeY , eyeZ , centerX , centerY , centerZ , upX , up
Y , upZ
    CALL glClearColor .8 , .8 , .8 , 1
    Texture = 1
    CALL CreateBMPTexture "OpenGL_Logo.bmp" , Texture
' load texture and put it in texture #1

    Angle = 110
    Width = .5
    Depth = .5
    Height = 2
    cX = 0
    cY = 0
    cZ = 0
    Red = .5
    Green = 0
    Blue = 0
```

```
    Sides = 200

    CALL glGenLists 1
    CALL glNewList 1 , 4865
      CALL
 BuildTextureCylinder Angle , Width , Depth , Height , cX , cY , cZ ,
Texture , Sides
    CALL glEndList

    FOR a  = 1 TO 360
      CALL
 ClearView eyeX , eyeY , eyeZ , centerX , centerY , centerZ , upX , up
Y , upZ
      CALL glRotatef a  , 1 , 0 , 0
      CALL glRotatef a  , 0 , 1 , 0
      'CALL glRotatef a  , 0 , 0 , 1
      CALL glCallList 1

      CALL RefreshView
      CALL Pause 15
    NEXT a


    WAIT


SUB
 BuildTextureCylinder Angle , W , D , H , cX , cY , cZ , tex , Sides
    GL.QUAD.STRIP = 8
    GL.TEXTURE.2D = 3553

    CALL glEnable GL.TEXTURE.2D
    CALL glBindTexture GL.TEXTURE.2D , tex
    PI = 3.14159265

    sin.angle = Sin(Angle * PI / 180)
    cos.angle = Cos(Angle * PI / 180)

    theta = 0
    dtheta = 2 * PI / Sides

    TexCoordinate=1

    XOval = W * Cos(theta)
    YOval = D * Sin(theta)
    X1 = cX + XOval * cos.angle - YOval * sin.angle
```

```
    Z1 = cZ - XOval * sin.angle - YOval * cos.angle

    ' X2 , Z2 values for the first glNormal call
    XOval = W * Cos(dtheta)
    YOval = D * Sin(dtheta)
    X2 = cX + XOval * cos.angle - YOval * sin.angle
    Z2 = cZ - XOval * sin.angle - YOval * cos.angle

    CALL glBegin GL.QUAD.STRIP

      WHILE theta < 2 * PI

        CALL glNormal X1 , cY+(H/2) , Z1 , X2 , cY+(H/2)
 , Z2 , X1 , cY-(H/2) , Z1
        CALL TextureVertex TexCoordinate , 1 , X1 , cY+(H/2) , Z1
        CALL TextureVertex TexCoordinate , 0 , X1 , cY-(H/2) , Z1

        theta = theta + dtheta
        XOval = W * Cos(theta)
        YOval = D * Sin(theta)
        X2 = X1
        Z2 = Z1
        X1 = cX + XOval * cos.angle + YOval * sin.angle
        Z1 = cZ - XOval * sin.angle + YOval * cos.angle

        TexCoordinate = TexCoordinate - (1/Sides)

      WEND

      CALL glNormal X1 , cY+(H/2) , Z1 , X2 , cY+(H/2)
 , Z2 , X1 , cY-(H/2) , Z1
      CALL TextureVertex TexC , 1 , X1 , cY+(H/2) , Z1
      CALL TextureVertex TexC , 0 , X1 , cY-(H/2) , Z1

    CALL glEnd
END SUB
```

Next we will be creating "Transparent Surfaces and Fog"