RENDERING ENGINE

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graphics software frameworks

Provide wrappers around the graphics APIs and often needed functionality to allow faster development of graphics applications in support the developers

features of rendering engines

- Loading and rendering of 3D models.
- Loading and manipulation of different kind of image formats.
- Applying textures, shading and more advanced effects to models.
- Organization of the models for easy execution of different operations on the models.
- Performance optimizations for faster rendering of the models.

Rendering pipeline

The rendering pipeline describes the traditional processing steps taken by 3D real-time rendering applications (RTR-applications)

Graphics processing steps

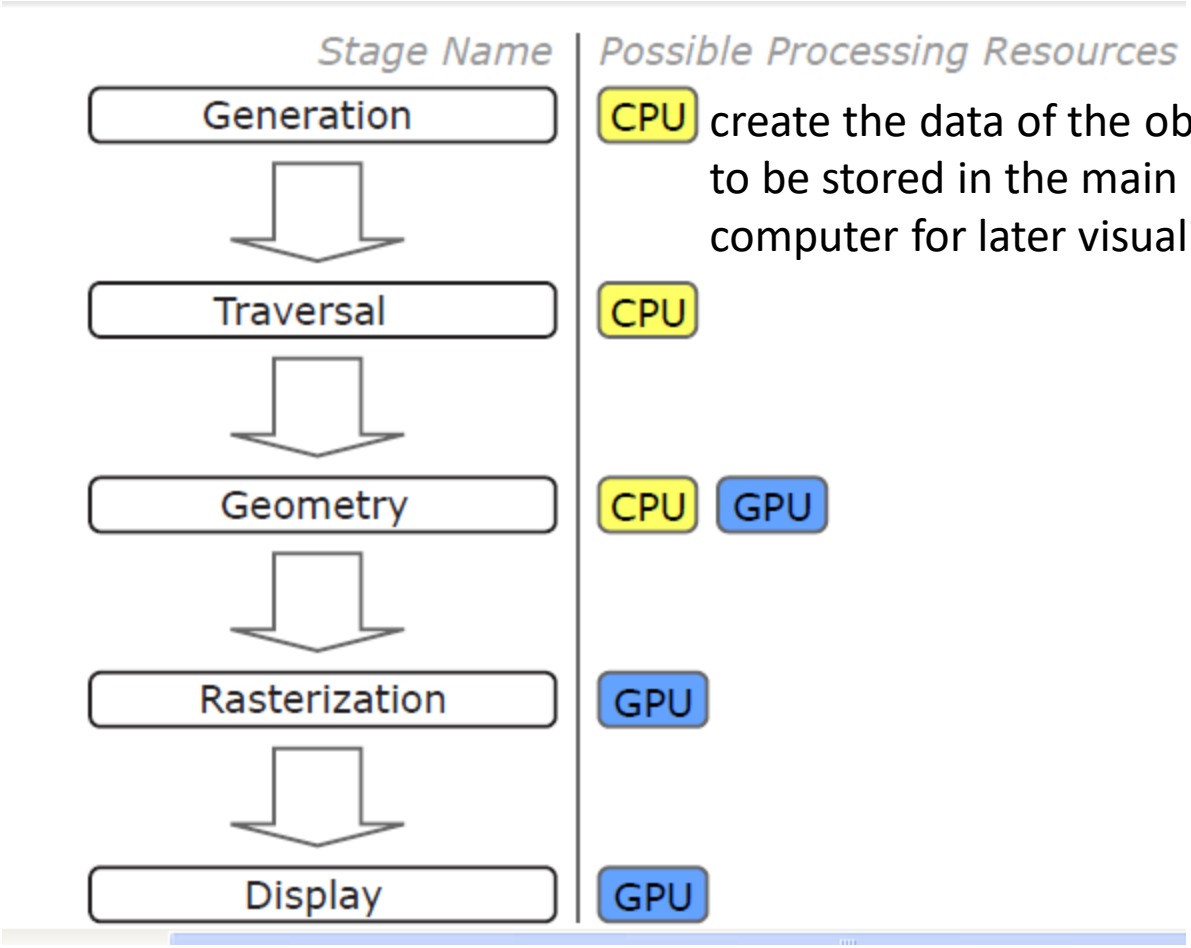
•Any RTR-application needs data it can visualize. Therefore, it can generate the data or it can load it directly from a storage medium.

• This data has to be organized and prepared for rendering by the program.

• The data has to be transformed to fit into the viewport of the output device.

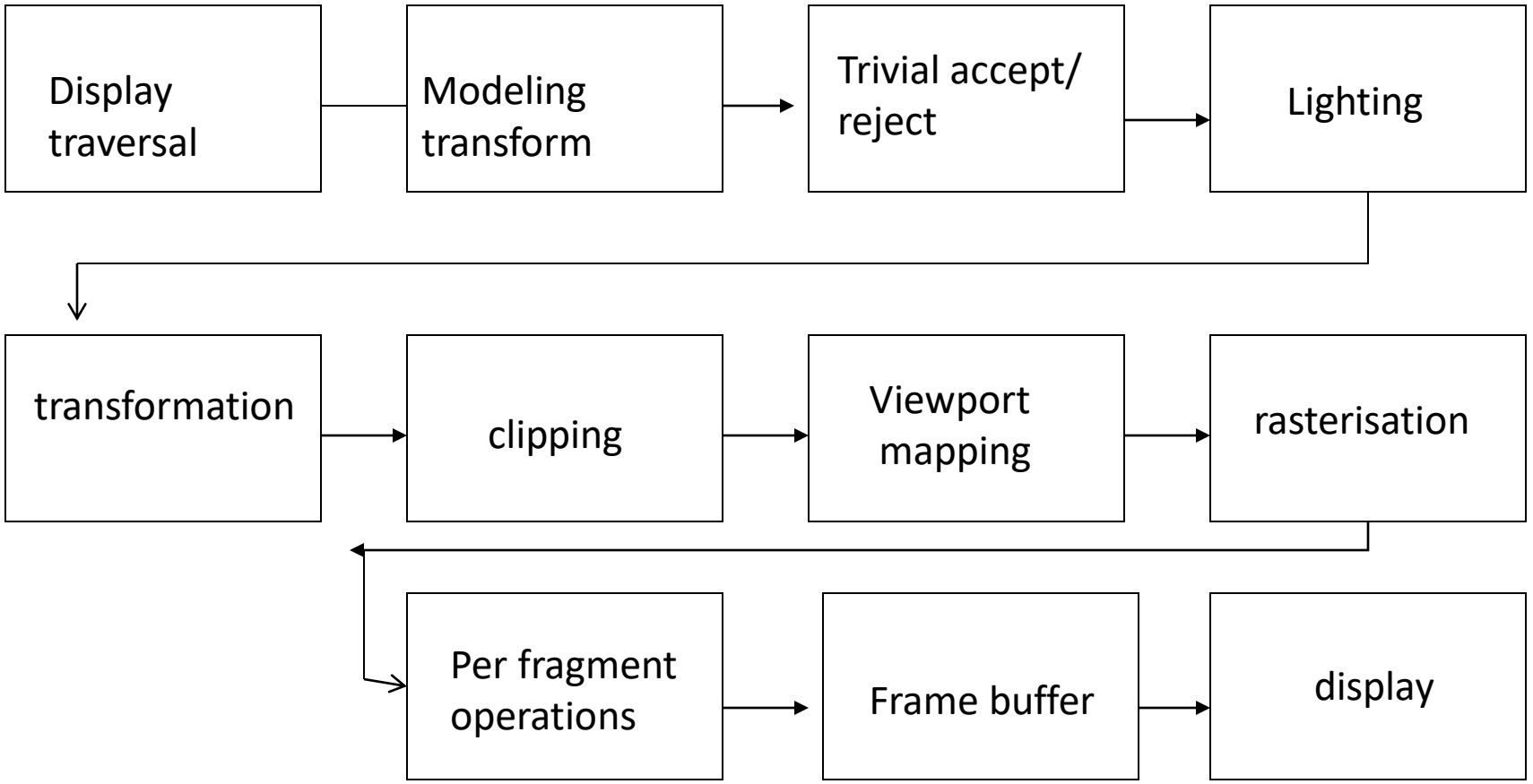
• Afterwards, the data is converted into pixels and displayed at the output device.

Graphics processing steps



create the data of the object which have to be stored in the main memory of the computer for later visualization.

GRAPHIC ENGINE ARCHITECTURE



GRAPHIC ENGINE ARCHITECTURE

- Geometry processing:
  - 3D Polygons to 2D poly-gons (in screen coordinates).
  - Transformation from local to world coordinates.
  - Lighting at vertices.
  - Transforming to a canonical view volume.
  - Clipping.
  - Perspective projection.
  - Transformation to screen coordinates.

GRAPHIC ENGINE ARCHITECTURE

- Rasterization:
  - Conversion of 2D polygons to pixels information.(Scan conversion).
  - Convert the triangle into fragments by interpolating the vertex attributes of the triangle corners. The interpolated attributes are e.g. the color, texture coordinates and depth values.
  - Shading.
- Per-fragment operations
  - Perform owner, scissor, alpha transparency and stencil tests on the fragment. Using such tests fragments can be discarded before they get displayed.
  - • Calculate the fragments' final color using lighting, texture mapping and alpha
  - blending.
  - Hidden surface removal.
    - Resolve visibility among fragments by testing their depth values against the depth value stored in the Z-buffer
- Frame buffer

GRAPHIC ENGINE ARCHITECTURE

- Display
  - Converting pixels to analog display signals
- At the display stage, gamma correction can be applied to the colors of the fragments following Equation

$$I = \alpha(V + \varepsilon)^{\gamma}$$

- where V is the voltage input, α and y (gamma) are constant for each monitor, ε is the black level (brightness) setting for the monitor, and I is the generated intensity.
- The intensity is then converted into electrical voltage output to be used by output devices to display the content of the frame buffer.

Components of a Graphics Software System

Primitives routine/functions

Graphic API

Windowing support libararies

Windowing Support Libraries

Windowing systems are platform dependent

? Support libraries:

– GLX: OpenGL Extension to the X Window System,
functions begin with glX

– WGL: Microsoft Windows-to-OpenGL interface,
functions begin with wgl

• Comes with Microsoft Visual Studio

– AGL: Apple GL, functions begin with agl

– GLUT: OpenGL Utility Toolkit

• A library of functions for interacting with screenwindowing system, functions begin with glut

• Works with many different platforms

• Doesn’t come with Visual Studio, but easily obtained

Using the GLUT in OpenGL Windows Applications -Visual Studio 2005-

Download the Windows version from:
– http://www.xmission.com/~nate/glut.html
?Copy files to following directories:
– glut32.dll to: Windows\system32
– glut32.lib to: Program Files\Microsoft Visual Studio 8\VC\PlatformSDK\lib
– glut.h to: Program Files\Microsoft Visual Studio 8\VC\PlatformSDK\include\gl

Using GLUT from VS 2008

Could download the GLUT libraries and header files
? But it's more complex to put them in the correct directories
? Easier to go to the following website and download an installer which will get the libraries and install them in the right places:
– http://tempvariable.blogspot.com/2008/02/installing-freegluton-visual-studio.html
? Click on the package link in the fourth paragraph
– And download the freeglut glut.zip file (229.4 KB)
– After unzipping it, run the install.bat file