DIRECTX 11

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Application Programming Interface is a set of ready-made classes, procedures, functions, structures and constants provided by the application (libraries, services) for use in external software. It is used by programmers to write various applications.

DirectX is a set of API which was created for programming on Microsoft Windows operating system. Mostly it is used to write computer games. DirectX Software Development Kit is available for free downloading from Microsoft homepage. The updated versions of DirectX are usually included with the gaming application because of constant updates and additions.

Almost all of the DirectX API parts are a set of COM-compatible objects. Component Object Model is a technological standard from Microsoft designed to create software, based on the interactive components, where each of them can be used simultaneously in many programs.

General components of DirectX are:

- DirectDraw for video renderer in media applications;
- DirectWrite for Fonts;
- Direct2D for 2D Graphics;
- Direct3D (D3D) for drawing 3D graphics;
- DXGI for support Direct3D 10 and up;
- DirectCompute for GPU Computing;
- DirectSound3D (DS3D) for the playback of 3D sounds;
- DirectX Media, consisting of DirectAnimation for 2D/3D web animation, DirectShow for multimedia playback, DirectX Transform for web interactivity and Direct3D Retained Mode for higher level 3D graphics; DirectShow contains DirectX plug-ins for audio signal processing and DirectX Video Acceleration for accelerated video playback.
- DirectX Diagnostics (DxDiag) to diagnose and generate reports on components related to DirectX, such as audio, video, and input drivers.
- DirectSetup for the installation of DirectX components, and the detection of the current DirectX version.

DirectX 11 (D3D11) is a component of API, the 11th version of Direct3D and the successor to Direct3D 10/10.1. Direct3D 11 provides functions to communicate the operating system and applications from the video card drivers. Partly D3D11 works on Direct3D 9-10 card-level.

The official final version was released on October 22, 2009 as a part of Windows 7.

The first D3D11 graphics processor became the AMD RV870 whose publication took place on September 23, 2009. NVIDIA GF100 became the rival of AMD RV870 chip based on Fermi architecture, which also had hardware support of Direct3D 11.

One of the most important DirectX 11 features is Tessellation which can significantly change the work with 3D graphics on PC. Basically, tessellation is a method to partition polygons into smaller parts. For example, if one takes a square and cuts the diagonal, this square is "tessellated" into two triangles. Tessellation does not greatly contribute realism — nothing changes if in a computer game the square is rendered as two triangles or two thousand

triangles. Tessellation improves realism in the case if new triangles are used to describe some new information.

The easiest and most popular way to take advantage of new triangles is displacement maps. The displacement map is a texture that stores height data. The map applied to the surface allows you to "shift" the top surface up or down based on the height data.

Tessellation is involved to create flat and smooth model lines. The Valve and id Software developers have done a great job to integrate these technologies to the existing game characters and got promising results.
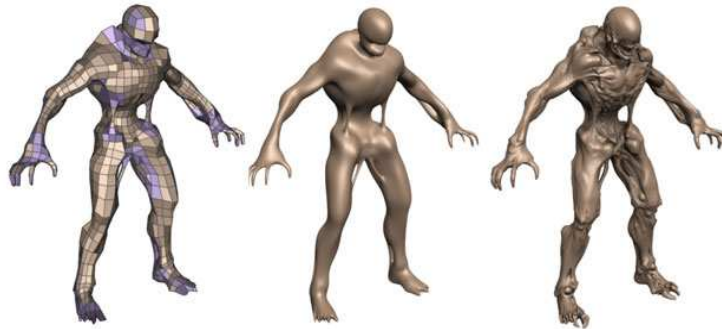

Fig.1. The process of tessellation model, id software.

Displacement map can be applied as an alternative to current techniques of bump mapping. Recent technologies such as a method to create relief with normals, make the illusion of bumpy surface due to more accurate shading pixels. All similar techniques work only in certain cases and seem partly convincing. For example, parallax occlusion mapping method is the most advanced one to produce bumps. Although there is an illusion of self-shadowing geometry the method can be applicable but to flat surfaces and can create an effect only on the inside of the object. The creation of relief with the displacement map which is supported tessellation has no such problems and provides accurate results from any angle.

Base Model   Bump Mapping   Displacement Mapping

Image courtesy of www.chromesphere.com

Fig.2. Comparison of bump's technology.

Another close tessellation assistant is a model improving algorithm. It takes a rough model and uses tessellation to create a smoother and more accurate model. These algorithms allow avoiding many visual artifacts of modern games, for example, the car wheels with a polygonal appearance.

Fig.3

In games with large open landscapes distant objects appear and disappear in the scene. This results from the game engine switching between levels of detail, optimizing the processing of loading geometry. Originally there was not a simple and convenient method of smooth variation of the detail level, since it would require keeping many versions of a model or the scene environment. The dynamic tessellation can solve the problem by changing the level of detail in real time, for example, when the first appearance of a distant building is rendered using only ten triangles. When approaching, more detailed features appear and additional triangles are used to clarify details such as windows and roof. When one finally reaches the door, thousands of triangles are used to render the only one door's handle, and each bend is carefully carved with displacement maps. Thus, due to the dynamic tessellation objects do not appear and disappear in the frame and gaming environment can be infinitely detailed.

DirectX 11 is not a cross platform API (like OpenGL), what probably is its main weakness. But still, API under Microsoft Windows has a huge visual and software possibilities, which makes it not just another modification of itself, but a new standard for developers of graphics and gaming applications.