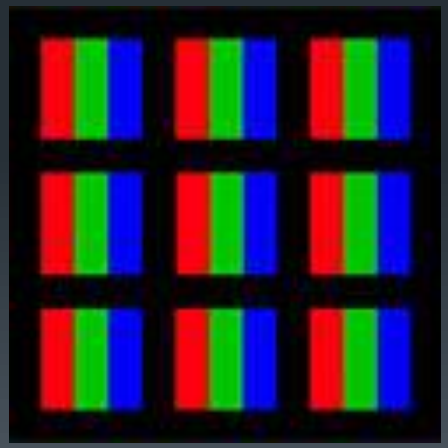
1. Introduction

Introduction to Computer Graphics

Display and Input devices

Display and Input Technologies

Physical Display Technologies



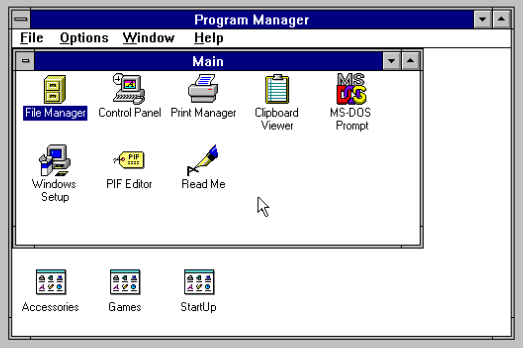
Pixels up Close

- The first modern computer display devices we had were cathode ray tube (CRT) monitors which used the same technology as TV screens.
- The monitor was made up of thousands of picture elements (pixels), each pixel was made up of three colored blocks: red/green/blue (RGB)
- The RGB color model is an additive one, which means that the three primary colors RGB are added together to reproduce other colors.
- There is another color model which is subtractive, called the CYMK (cyan/yellow/magenta/key), this is mainly used in print media.
- There is a third common color model, HSV (Hue/Saturation/Value), which can be seen as a more accurate form of RGB and is commonly used in digital art applications (e.g. Photoshop) for color selection.

Physical Display Technologies

- It is through a combination of the RGB colors that each pixel gets its own color, and all these colored pixels put together generate the image you see on a monitor.
- A monitor's resolution specifies the dimensions of the viewable area of a monitor in pixels. The most common desktop resolution today is 1280x1024 which means there are 1280 pixels across and 1024 pixels down.
- For animation, the monitor needs to update the displayed image. To do this the display needs to be redrawn, the number of times the display is redrawn a second is called the refresh rate. Most CRT monitors have a refresh rate of 60 ~ 75 hz (hertz means cycles per second)
- LCD monitors operate in a different manner to CRTs, and so don't have refresh rates but rather a response time, which defines how long it takes for a pixel to change color. Most LCDs today have responses times ranging from 2ms to 16ms

Input Devices



- One of the very first uses of computer graphics was for graphical user interfaces (GUI), these graphical user interfaces required a new method of input and so the mouse was developed.
- Physical input is input resulting from an input device like a mouse or keyboard.
- Logical input results from a virtual source, that is often manipulated via physical input. I.E. GUI buttons.

CAD, SFX, Games, Simulations

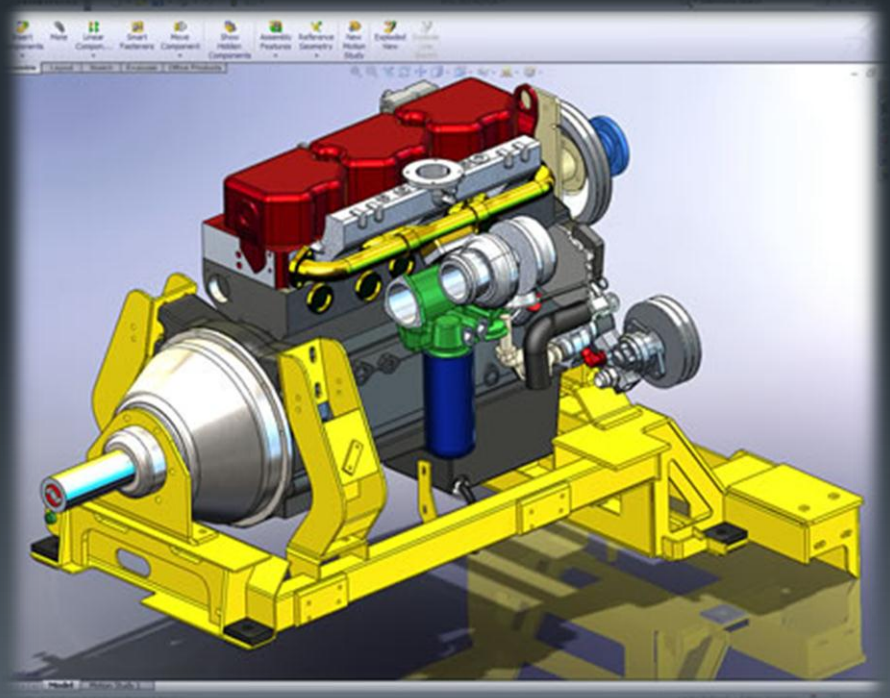
Uses of Computer Graphics

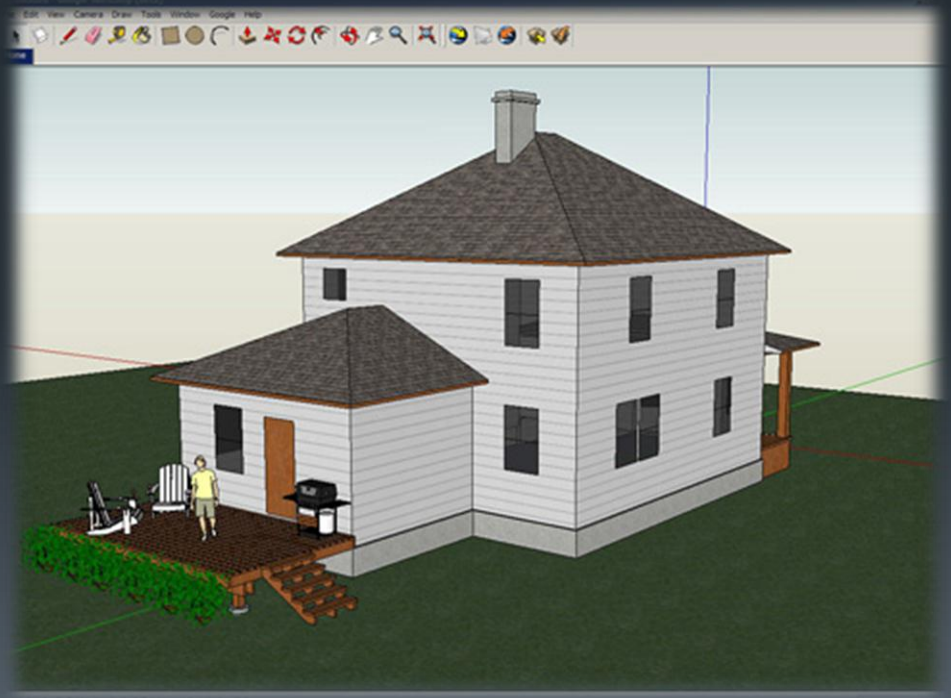
3D Animation and SFX

- Used heavily in the movie industry by companies such as Pixar, DreamWorks.
- Special Effects in movies (e.g. 300, Sin City, etc.)

Computer Aided Design (CAD)

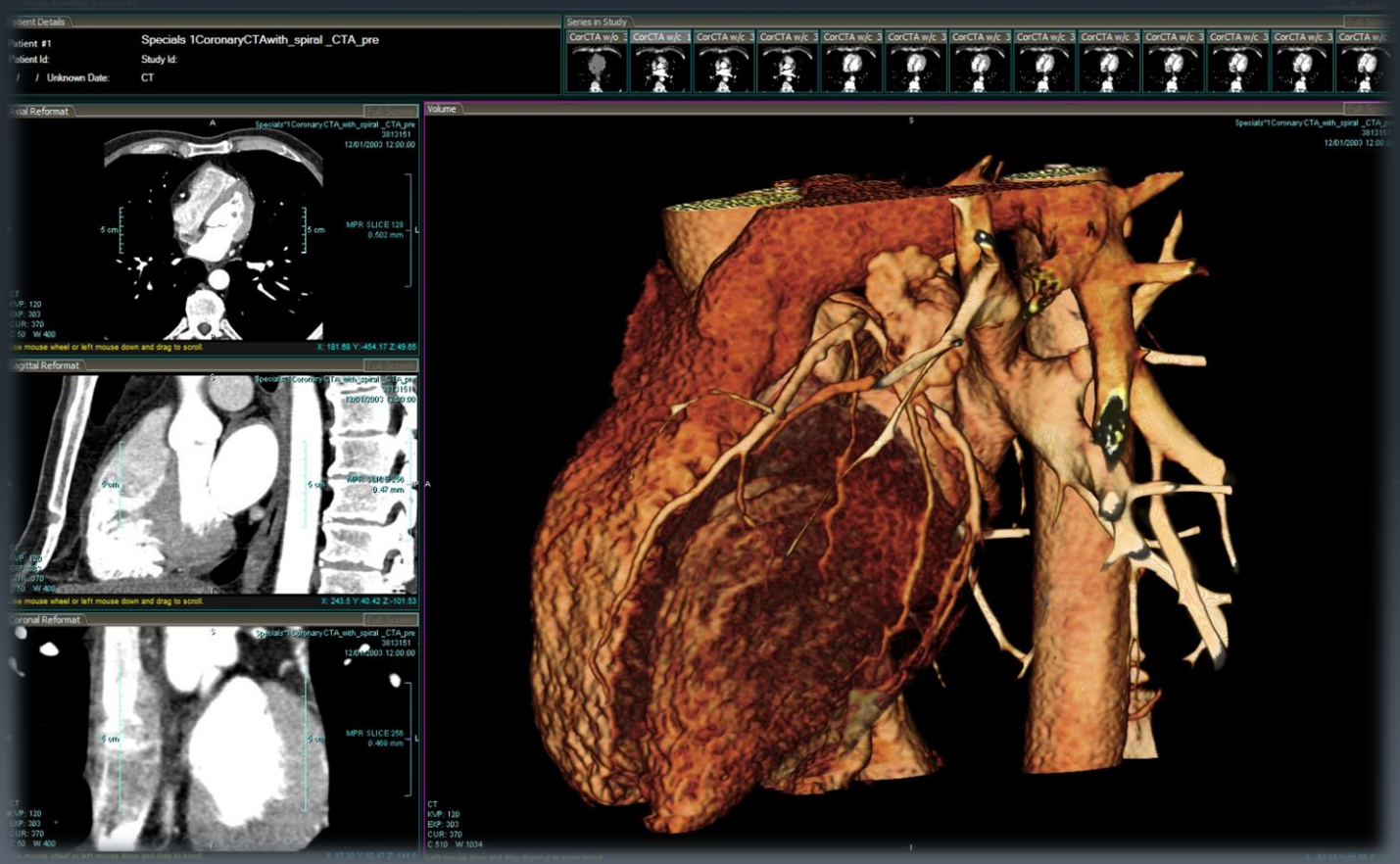
- The biggest computer graphics industry
- Used in almost all industrial design fields such as: Architecture, Engineering, etc…





Medical Visualization

- 3D MRI
- Dental and bone scans



Simulations

- Training aids for machinery operators, soldiers, pilots, etc…

Video Games

- Multi Billion Dollar Industry
- Pushing the limits of current graphical technology
- The Driving Force behind GPU development!

A History of Computer Graphics in Video Games

Computer Graphics Advancements

3D Graphics In Games: 1993

ID Software's Doom – 2D Software Rendering - 1993

3D Graphics In Games: 1996

ID Software's Quake – 3D Software Rendering – June 1996

GPU Hardware in 1996

3DFX Voodoo 1

Interface: PCI
Shader Model: N/A
DirectX: 3
Manufacturing Process: 0.5 micron
Core Clockspeed: 50MHz
Memory Amount: 8MB
Memory Clockspeed: 50MHz
Memory Bus: 64-bit
Transistors: 1 million

3D Graphics In Games: 1997

ID Software's Quake 2 – 3D Hardware Rendering – December 1997

GPU Hardware in 1999

NVIDIA Riva TNT2

Interface: AGP
Shader Model: N/A
DirectX: 6
Manufacturing Process: 0.25 micron
Core Clockspeed: 125MHz
Memory Amount: 32MB
Memory Clockspeed: 150MHz
Memory Bus: 128-bit
Transistors: 15 million

GPU Hardware in 1999

NVIDIA Geforce 256 DDR

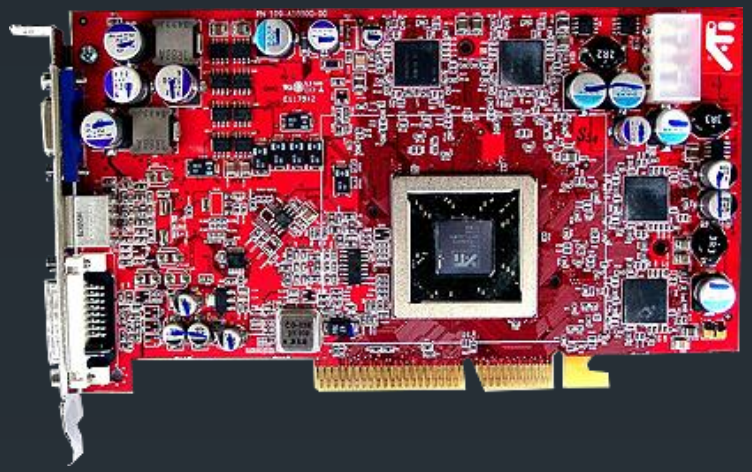
Interface: AGP
Shader Model: N/A
DirectX: 7
Manufacturing Process: 0.22 micron
Core Clockspeed: 120MHz
Memory Amount: 64MB
Memory Clockspeed: 150MHz
Memory Bus: 128-bit
Transistors: 23 million

3D Graphics In Games: 1999

ID Software's Quake 3 Arena – 3D Hardware Rendering – December 1999

GPU Hardware in 2002

ATI Radeon 9700pro



Interface: AGP
Shader Model: 2.0
DirectX: 9
Manufacturing Process: 0.15 micron
Core Clockspeed: 275MHz
Memory Amount: 128MB
Memory Clockspeed: 270MHz
Memory Bus: 128-bit
Transistors: 107 million

3D Graphics In Games: 2003

Infinity Ward's Call of Duty (Quake 3 engine) – 3D Hardware Rendering - 2003

GPU Hardware in 2005

NVIDIA Geforce 6800GT

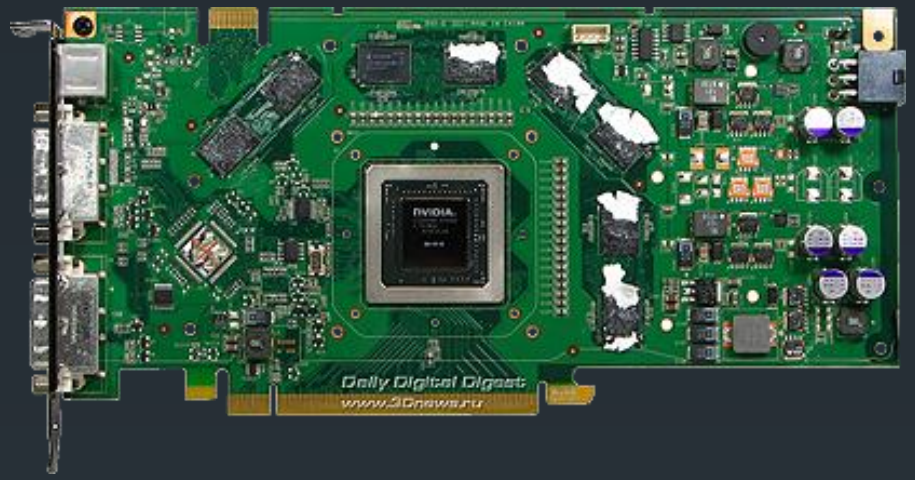
Interface: AGP
Shader Model: 3.0
DirectX: 9
Manufacturing Process: 0.13 micron
Core Clockspeed: 350MHz
Memory Amount: 256MB
Memory Clockspeed: 1000MHz
Memory Bus: 256-bit
Transistors: 222 million

3D Graphics In Games: 2005

Infinity Ward's Call of Duty 2 (Modified Quake 3 engine) – 3D Hardware Rendering - 2005

GPU Hardware in 2006

NVIDIA Geforce 8800GTX



Interface: PCIe
Shader Model: 4.0
DirectX: 10
Manufacturing Process: 90 nanometer
Core Clockspeed: 575MHz
Memory Amount: 796MB
Memory Clockspeed: 1800MHz
Memory Bus: 384-bit
Transistors: 484 million

3D Graphics In Games: 2007

Infinity Ward's Call of Duty 4 – 3D Hardware Rendering - 2007

GPU Hardware Now

NVIDIA Geforce GTX580

Interface: PCIe 2.0 x16
Shader Model: 5.0
DirectX: 11
Manufacturing Process: 40 nanometer
Core Clockspeed: 770MHz
Memory Amount: 1536MB
Memory Clockspeed: 2004MHz
Memory Bus: 384-bit
Transistors: 3 billion

3D Graphics in Games: The Future

CRYTEK's Cryengine3 – 3D Hardware Rendering – 2010/2011

The Current State of Computer Graphics Technology

Computer Graphics Today

Computer Graphics Today

- The CPU vs. GPU battle
- Fusion – CPUs with GPUs embedded
  - Intel Sandy Bridge (DX10 GPU on chip)
- Hardware rendering in mobile devices
  - NVIDIA Tegra (New Android Platform)
  - Imagination Technologies PowerVR (iPhone, certain android handsets)
  - Windows Phone 7 – XNA compliant DX9 GPU
- OpenCL/CUDA frameworks
  - Allowing GPUs to be used for generic processing
  - Allows for more realistic graphics due to higher quality physics