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The History of Computer Graphics

İTÜ Computer Engineering

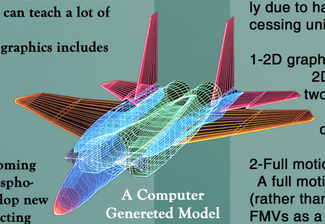
Eyes are the most developed sensors of our body; with an image an information can be learned much faster than explaining it verbally. Computer graphics are the best way to transfer information from data to human brain via eyes. Computer generated images are very efficient and widely used in public media, on hospitals and in scientific material. A well-crafted graph can show different statistics in a very efficient way or a 3 dimensional movie of human body can teach a lot of things about biology.
Computer Graphics represents everything on a computer that it is neither text nor sound. Computer graphics includes but not limited to,

- Manipulation of images,
- Creation of animation and images,
- Processing and simulating various scientific experiments.

An Oscilloscope

Oscilloscope

An oscilloscope is a device to reflect electric waves. Electrons which are coming from a cathode tube gets manipulated via magnets to reflect wave on a phosphorus surface. Visualizing electric helps to understand electricity and to develop new electronic components. Besides that oscilloscopes brought the idea of reflecting something via electrical waves. First game created for such devices was a tennis game, and it was played by two person and players could use a knob to control the angle and click a button to hit the ball.



A Computer Genereted Model of a plane

Animation and CGI

3D animation is a process that involves taking fully 3D objects (whether they are physical or digital) and making them animate and move. Most 3D animation today is done using CGI (computer-generated imagery). The first cinema feature movie to make extensive use of solid 3D CGI was Walt Disney's Tron. Although it has been used in films since the 1980s, it wasn't used in large quantities until 1995, when Pixar Animation Studios released the first all-CGI film ever made, Toy Story.

Cgı-Computer Generated Imagery

CGI is the application of computer graphics to create or contribute to images in art, printed media, video games, films, television programs, commercials, videos, and simulators. The visual scenes may be dynamic or static, and may be two-dimensional (2D), though the term "CGI" is most commonly used to refer to 3D computer graphics used for creating scenes or special effects in films and television.

3d Animation Softwares

The 80s saw the appearance of many notable new commercial software products:

- Autodesk Inc. – 3D Studio
- Softimage
- Side Effects Software

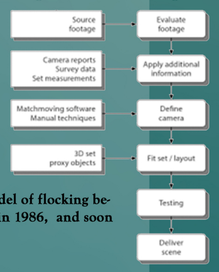
Other notable softwares in 1990s and2000s:

- Autodesk Maya
- Blender
- Cinema4D

Some techniques of CGI are:

Some of Computer Generated Characters

Diagram of Match Moving :



Flocking:

Flocking is computer model of coordinated animal motion such as bird flocks. The mathematical model of flocking behavior was first simulated on a computer with an artificial life program devoloped by Craig Reynolds in 1986, and soon started to be used in animation.

Motion capture:

Motion capture, or "Mocap", is the technology that enables the process of translating a live performence into a digital performance with collecting data that represents motion. A performer wears markers near each joint to identify the motion by the positions or angles between the markers. Many different types of markers can be used—lights, reflective markers, LEDs, infra-red, inertial, mechanical, or wireless RF—and may be worn as a form of suit, or attached direct to a performer's body.

Match moving(motion tracking/camera tracking):

Match moving ,unlike to motion capture, instead of using special cameras and markers to record the motion, uses pre-existing live-action footage and computer software to track specific points in the scene. Therefore, allows the insertion of CGI elements into the shot with correct position, scale, orientation, and motion relative to the existing material. The technique can be 2D or 3D, and can also include matching for camera movements.

Virtual studio

In television, a virtual studio, or virtual set, is a studio that allows the real-time combination of people or other real objects and computer generated environments and objects in a seamless manner.

Game Graphics

A variety of computer graphic techniques have been used to display video game content throughout the history of video games. The predominance of individual techniques have evolved over time, primarily due to hardware advances and restrictions such as the processing power of central or graphics processing units.

1-2D graphics

2D computer graphics is the computer-based generation of digital images—mostly from two-dimensional models (such as 2D geometric models, text, and digital images) and by techniques specific to them. The word may stand for the branch of computer science that comprises such techniques, or for the models themselves.

2-Full motion video

A full motion video (FMV) is a video game narration technique that relies upon pre-recorded video files (rather than sprites, vectors, or 3D models) to display action in the game. While many games feature FMVs as a way to present information during cutscenes, games that are primarily presented through FMVs are referred to as full-motion video games or interactive movies.

3-2.5D, 3/4 perspective, and pseudo-3D

2.5D ("two-and-a-half-dimensional"), ¾ perspective, and pseudo-3D are terms, mainly in the video game industry, used to describe either 2D graphical projections and similar techniques used to cause a series of images (or scenes) to simulate the appearance of being three-dimensional (3D) when in fact they are not, or gameplay in an otherwise three-dimensional video game that is restricted to a two-dimensional plane or has a virtual camera with a fixed angle. By contrast, games using 3D computer graphics without such restrictions are said to use true 3D.

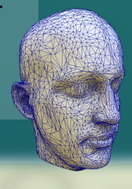
4-3D

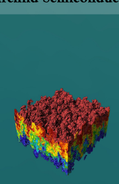
3D computer graphics (in contrast to 2D computer graphics) are graphics that use a three-dimensional representation of geometric data (often Cartesian) that is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be stored for viewing later or displayed in real-time.

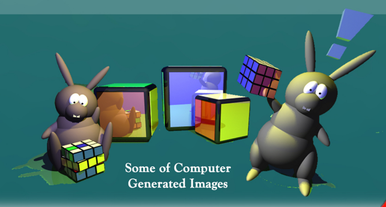
3D computer graphics rely on many of the same algorithms as 2D computer vector graphics in the wire-frame model and 2D computer raster graphics in the final rendered display. In computer graphics software, the distinction between 2D and 3D is occasionally blurred; 2D applications may use 3D techniques to achieve effects such as lighting, and 3D may use 2D rendering techniques.

Two Advanced Computer Graphic Companies: Nvidia and AMD

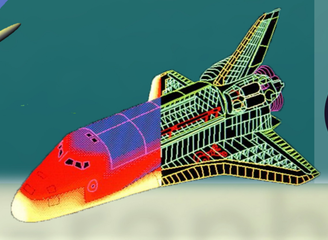
Nvidia Corporation (commonly referred to as Nvidia, stylized as NVIDIA, nVIDIA or nVidia) is an American worldwide technology company based in Santa Clara, California. Nvidia manufactures graphics processing units(GPUs), as well as system on a chip units (SOCs) for the mobile computing market. Nvidia's primary GPU product line, labeled "GeForce", is in direct competition with Advanced Micro Devices' (AMD) "Radeon" products.
Three people co-founded Nvidia in 1993:
Jen-Hsun Huang (CEO as of 2013), a Chinese-born American, previously Director of CoreWare at LSI Logic and amicroprocessor designer at Advanced Micro Devices (AMD).
Chris Malachowsky, an electrical engineer who worked at Sun Microsystems.
Curtis Priem, previously a senior staff engineer and graphics chip designer at Sun Microsystems.
The founders received venture capital funding from Sequoia Capital.
Advanced Micro Devices, Inc. (AMD) is an American worldwide semiconductor company based in Sunnyvale, California, United States, that develops computer processors and related technologies for business and consumer markets.
While initially it manufactured its own processors, the company became fabless after GlobalFoundries was spun off in 2009. AMD's main products include microprocessors, motherboard chipsets, embedded processors and graphics processors for servers, workstations and personal computers, and embedded systems applications.
Advanced Micro Devices was formally incorporated on May 1, 1969, by Jerry Sanders, along with seven of his colleagues from Fairchild Semiconductor.







Some of Computer Generated Images



Images

Images are data usually captured by a camera or a scanner or created by a computer. Those images has two basic types: vector and raster. Vector type pictures does not have much different formats but raster type images have a lot of different formats that server for different purposes. Therefore, there is no universal image format that is best for all scenarios. Every type of image format has their own advantages and disadvantages. Here is a summation of each image format, their pros and cons, as well as when and where it's best to use them. Print Graphics: TIFF is the best and only choice for professionals when images are intended for print. Its ability to read CMYK and YcbCr color, plus its ability to store such high pixel intensity makes it the only choice for designers, photographers and publishers.
Web Graphics: PNG, JPEG and GIF are the most web friendly image formats there is. JPEG is great for images when you need to keep the size small, such as when you need to upload it online. If you don't mind compromising the quality of the image a bit, use JPEG. If you want to keep the size small, but still retain the image quality, use PNG. GIF is the worst choice, although file sizes are very small, and they load very fast. Plus, if you want to add animation effects, use GIF.

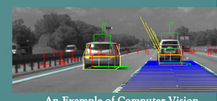
Image Processing

Image processing is a method to convert an image into digital form and perform some mathematical operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics or parameters associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.
It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans).

Image processing basically includes the following three steps:
·Importing the image with optical scanner or by digital photography.
·Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
·Output is the last stage in which result can be altered image or report that is based on image analysis.

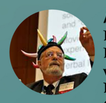
Purpose of Image Processing

The purpose of image processing is divided into 5 groups. They are:
1.Visualization - Observe the objects that are not visible.
2.Image sharpening and restoration - To create a better image.
3.Image retrieval - Seek for the image of interest.
4.Measurement of pattern – Measures various objects in an image.
5.Image Recognition – Distinguish the objects in an image.



An Example of Computer Vision

Pioneers at Computer Graphics



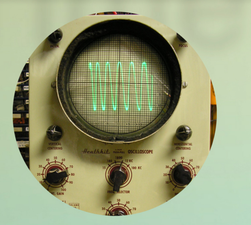
Aaron Marcus
In 1969-71, he programmed a prototype desktop publishing page-layout application for AT&T Bell Labs. In 1971-73, he claims to have programmed some of the first virtual reality art/design spaces ever created while a faculty member at Princeton University. In the early 1980s, he was a Staff Scientist at Lawrence Berkeley Laboratory in Berkeley, as well as a faculty member of the University of California at Berkeley's College of Environmental Design. In 1982, he founded Aaron Marcus and Associates, Inc. (AM+A), a user-interface design and consulting company, one of the first such independent, computer-based design firms in the world.

Michael Noll
Noll used a digital computer to create artistic patterns and formalized the use of random and algorithmic processes in the creation of visual arts. Noll constructed interactive three-dimensional input devices and displays and a three-dimensional, tactile, forcefeedback ("feelie") device (US patent 3,919,691 "Tactile Man-Machine Communications System" filed May 26, 1971, issued November 1, 1975). This device was the forerunner of today's virtual-reality systems, and Noll suggested its use as a way for the blind to "feel" computer graphics.

Pierre Bézier
Pierre Étienne Bézier was a French engineer and one of the founders of the fields of solid, geometric and physical modeling as well as in the field of representing curves, especially in CAD/CAM systems. As an engineer at Renault, he became a leader in the transformation of design and manufacturing, through mathematics and computing tools, into computer-aided design and three-dimensional modeling.

John Carmack
Carmack has pioneered or popularized the use of many techniques in computer graphics, including "adaptive tile refresh" for Commander Keen, raycasting for Hovertank 3-D, Catacomb 3-D, and Wolfenstein 3-D, binary space partitioning which Doom became the first game to use, surface caching which he invented for Quake, Carmack's Reverse (formally known as z-fail stencil shadows) which he devised for Doom 3, and MegaTexture technology, first used in Enemy Territory: Quake Wars.

Timeline of Computer Graphics:



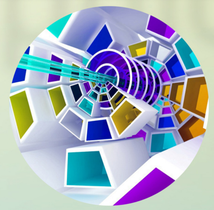
First Osiloscope 1920s

Tennis for Two Game on Osiloscope 1950s

First Computer Generated Film 1960s

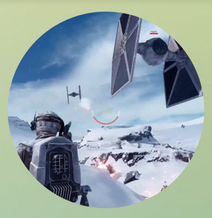
Development of 3D Modelling 1970s

Graphic Interface Gets Popular 1980s



Massive 3D Model Use in Public Media 1990s

CGI and Video Game Spread 2000s



Photorealistic Graphics 2010s