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Computer Graphics

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The term *Computer Graphics* was coined in 1960 by Will iam Fetter, a designer for Boeing. Computer Graphics is the technology with which pictures in the general sense are generated or managed, displayed, and processed in an application-oriented manner by means of computers, and with which pictures are also correlated with non-graphical application data. The term computer graphics also implies the computer-aided integration and handling of these pictures synchronized with other data types. Today computer graphics is already the basic technology for visualization and implementing interactive graphics dialogues for design and engineering applications (CAD, CAE, CAM, CIM, etc.), for printing, publishing, and office applications, or media and visual communication, for geographical information systems (GIS), and for architecture or civil engineering applications [1].

Computer graphics is any type of images created using any kind of computer. There is a vast amount of types of images a computer can create. Further advances in computing led to greater advancements in interactive computer graphics. In 1959, the TX-2 computer was developed at MIT's Lincoln Laboratory. The TX-2 integrated a number of new man-machine interfaces. A light pen could be used to draw sketches on the computer using Ivan Sutherland's revolutionary Sketchpad software [2]. Using a light pen, Sketchpad allowed one to draw simple shapes on the computer screen, save them and even recall them later. The light pen itself had a small

photoelectric cell in its tip. This cell emitted an electronic pulse whenever it was placed in front of a computer screen and the screen's electron gun fired directly at it. By simply timing the electronic pulse with the current location of the electron gun, it was easy to pinpoint exactly where the pen was on the screen at any given moment. Once that was determined, the computer could then draw a cursor at that location.

Sutherland seemed to find the perfect solution for many of the graphics problems he faced. Even today, many standards of computer graphics interfaces got their start with this early Sketchpad program. One example of this is in drawing constraints. If one wants to draw a square for example, he or she does not have to worry about drawing four lines perfectly to form the edges of the box. One can simply specify that he wants to draw a box, and then specify the location and size of the box. The software will then construct a perfect box, with the right dimensions and at the right location. Another example is that Sutherland's software modeled objects – not just a picture of objects. In other words, with a model of a car, one could change the size of the tires without affecting the rest of the car. It could stretch the body of the car without deforming the tires.

All computer art is digital, but there are two very different ways of drawing digital images on a computer screen, known as raster and vector graphics. Simple computer graphic programs like Microsoft Paint and PaintShop Pro are based on raster graphics, while more sophisticated programs such as CorelDRAW, AutoCAD, and Adobe Illustrator use vector graphics. So what exactly is the difference?

Raster graphics are digital images created or captured as a set of samples of a given space. A *raster* is a grid of x and y coordinates on a display space (and for three-dimensional images, a z coordinate). A raster image file identifies which of these coordinates to illuminate in monochrome or color values.

The raster file is sometimes referred to as a bitmap because it contains information that is directly mapped to the display grid.

There's an alternative method of computer graphics that gets around the problems of raster graphics. Instead of building up a picture out of pixels, you draw it a bit like a child would by using simple straight and curved lines called vectors or basic shapes (circles, curves, triangles, and so on) known as primitives. Staring at the screen, a vector-graphic picture still seems to be drawn out of pixels, but now the pixels are precisely related to one another – they're points along the various lines or other shapes you've drawn. Drawing with straight lines and curves instead of individual dots means you can produce an image more quickly and store it with less information. It's also much easier to scale a vector-graphic image up and down by applying mathematical formulas called algorithms that transform the vectors from which your image is drawn. A raster file is usually larger than a vector graphics image file. A raster file is usually difficult to modify without loss of information, although there are software tools that can convert a raster file into a vector file for refinement and changes. Examples of raster image file types are: BMP, TIFF, GIF, and JPEG files.

CG can be represented by 2D image or 3D model. 3D computer graphics is different from 2D computer graphics in that a three-dimensional representation of geometric data is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be for later display or for real-time viewing. 3D modeling is the process of preparing geometric data for 3D computer graphics, and is akin to sculpting or photography, whereas the art of 2D graphics is analogous to painting. Despite these differences, 3D computer graphics rely on many of the same algorithms as 2D computer graphics. 3D computer graphics in contrast to 2D computer graphics are graphics that use a three-dimensional

representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images. 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 primarily 3D may use 2D rendering techniques [3].

Computer graphics is also divided into interactive and non-interactive. In non-interactive computer graphics otherwise known as passive computer graphics, the observer has no control over the image. Familiar examples of this type of computer graphics include the titles shown on TV and other forms of computer art. Interactive Computer Graphics involves a two way communication between computer and user. Interactive computer graphics affects our lives in a number of indirect ways. For example, it helps to train the pilots of our airplanes. We can create a flight simulator which may help the pilots to get trained not in a real aircraft but on the grounds at the control of the flight simulator. The flight simulator is a mock up of an aircraft flight deck, containing all the usual controls and surrounded by screens on which we have the projected computer generated views of the terrain visible on take off and landing. Flight simulators have many advantages over the real aircrafts for training purposes, including fuel savings, safety, and the ability to familiarize the trainee with a large number of the world's airports.

And that's really the key point about computer graphics: they turn complex computer science into everyday art we can all grasp, instantly and intuitively. Virtually every modern computer now has what's called a GUI (graphical user interface), which means you operate the machine by pointing at things you want, clicking on them with your mouse or your finger, or dragging them around your desktop. That's why a picture really is worth a thousand words (sometimes many more) and why computers that help us visualize things with

computer graphics have truly revolutionized the way we see the world [4].

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