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RECENT TRENDS IN VIRTUAL REALITY AND COMPUTER GRAPHICS

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Abstract- **In today's world, animation, motion picture, advertisement, graphics and video games uses Computer Graphics. Here, some basic tools used to convert algorithm into color and text. Using Computer Graphics, physical body, data and imagination will be created. It represents graphical pattern of picture which can be combination of software and hardware. It helps to understand how image displayed on screen, moving object and provide interaction between user and system. Computer graphics depends upon internal model that is mathematical representation for graphics.Virtual Reality able to shift a human being into different environment without changing it's place. It is a part of simulation. Virtual Reality used in technology and social areas. This research work discussed about how graphics interactive in 2D and 3D ,shading and rendering, interactive components. Also Virtual Reality or Environment represented by application, technology and future work.**

***Index Terms*–Computer Graphics, animation, applications, virtual reality, virtual environment.**

I. Introduction

Computer Graphics is an interaction between user and computer. In graphics we can create images in 2D and 3D.Also rendering the image from 3D into 2D animation. Simulation can be done over the time.Graphics describes "almost everything on computers that is not text or sound".[1] Typically, the term computer graphics refers to several different things:

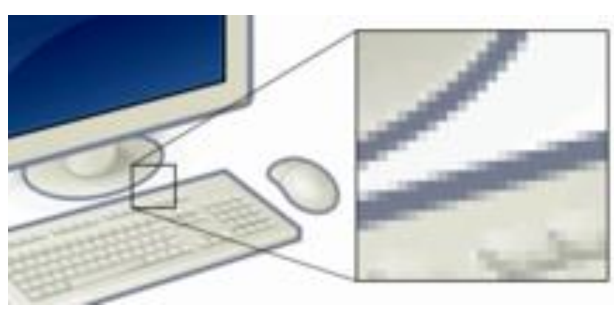
- the representation and manipulation of image data by a computer
- the various technologies used to create and manipulate images
- the sub-field of computer science which studies methods for digitally synthesizing and manipulating visual content, see study of computer graphics

A Computer graphics are pictures and films created using computers. Usually, the term refers to computer-generated image data created with help from specialized graphical hardware and software. It is a vast and recent area in computer science. The phrase was coined in 1960, by computer graphics researchers Verne Hudson and William Fetter of Boeing. It is often abbreviated as CG, though sometimes erroneously referred to as CGI**.** Computer graphics is responsible for displaying art and image data effectively and meaningfully to the user. It is also used for processing image data received from the physical world. Computer graphic development has had a significant impact on many types of media and has revolutionized animation, movies, advertising, video games, and graphic design generally.

II. Concepts and principles

Images are typically created by devices such as cameras, mirrors, lenses, telescopes, microscopes, etc.Digital images include both vector images and raster images, but raster images are more commonly used.

Pixel :



In the enlarged portion of the image individual pixels are rendered as squares and can be easily seen.

In digital imaging, a pixel[2] is a single point in a raster image. Pixels are placed on a regular 2-dimensional grid, and are often represented using dots or squares. Each pixel is a sample of an original image, where more samples typically provide a more accurate representation of the original. The intensity of each pixel is variable; in color systems, each pixel has typically three components such as red, green, and blue.Graphics are visual presentations on a surface, such as a computer screen. Examples are photographs, drawing, graphics designs, maps, engineering drawings, or other[3]. Graphics often combine text and illustration. Graphic design may consist of the deliberate selection, creation, or arrangement of typography alone, as in a brochure, flier, poster, web site, or book without any other element. Clarity or effective communication may be the objective, association with other cultural elements may be sought, or merely, the creation of a distinctive style.

Primitives

Primitives are basic units which a graphics system may combine to create more complex images or models. Examples would be sprites and character maps in 2d video games, geometric primitives in CAD, or polygons or triangles in 3d rendering. Primitives may be supported in hardware for efficient rendering, or the building blocks provided by a graphics application.[3]

Rendering

Rendering is the generation of a 2D image from a 3D model by means of computer programs. A scene file contains objects in a strictly defined language or data structure; it would contain geometry, viewpoint, texture, lighting, and shading information as a description of the virtual scene. The data contained in the scene file is then passed to a rendering program to be processed and output to a digital image or raster graphics image file. The rendering program is usually built into the computer graphics software, though others are available as plug-ins or entirely separate programs. The term "rendering" may be by analogy with an "artist's rendering" of a scene. Though the technical details of rendering methods vary, the general challenges to overcome in producing a 2D image from a 3D representation stored in a scene file are outlined as the graphics pipeline along a rendering device, such as a GPU. A GPU is a device able to assist the CPU in calculations. If a scene is to look relatively realistic and predictable under virtual lighting, the rendering software should solve the rendering equation. The rendering equation does not account for all lighting phenomena, but is a general lighting model for computer-generated imagery. 'Rendering' is also used to describe the process of calculating effects in a video editing file to produce final video output.

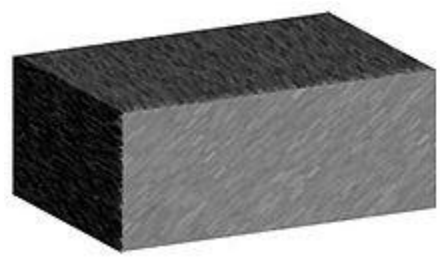
3D projection

3D projection is a method of mapping three dimensional points to a two dimensional plane. As most current methods for displaying graphical data are based on planar two dimensional media, the use of this type of projection is widespread, especially in computer graphics, engineering and drafting.

Ray tracing

Ray tracing is a technique for generating an image by tracing the path of light through pixels in an image plane. The technique is capable of producing a very high degree of photorealism; usually higher than that of typical scanline rendering methods, but at a greater computational cost.

Shading



Example of shading.

Shading refers to depicting depth in 3D models or illustrations by varying levels of darkness. It is a process used in drawing for depicting levels of darkness on paper by applying media more densely or with a darker shade for darker areas, and less densely or with a lighter shade for lighter areas. There are various techniques of shading including cross hatching where perpendicular lines of varying closeness are drawn in a grid pattern to shade an area. The closer the lines are together, the darker the area appears. Likewise, the farther apart the lines are, the lighter the area appears. The term has been recently generalized to mean that shaders are applied.

Texture mapping

Texture mapping is a method for adding detail, surface texture, or colour to a computer-generated graphic or 3D model. Its application to 3D graphics was pioneered by DrEdwin Catmull in 1974. A texture map is applied (mapped) to the surface of a shape, or polygon. This process is akin to applying patterned paper to a plain white box. Multitexturing is the use of more than one texture at a time on a polygon.[20]Procedural textures (created from adjusting parameters of an underlying algorithm that produces an output texture), and bitmap textures (created in an image editing application or imported from a digital camera) are, generally speaking, common methods of implementing texture definition on 3D models in computer graphics software, while intended placement of textures onto a model's surface often requires a technique known as UV mapping (arbitrary, manual layout of texture coordinates) for polygon surfaces, while NURBS surfaces have their own intrinsic parameterization used as texture coordinates. Texture mapping as a discipline also encompasses techniques for creating normal maps and bump maps that correspond to a texture to simulate height and specular maps to help simulate shine and light reflections, as well as environment mapping to simulate mirror-like reflectivity, also called gloss.

Anti-aliasing

Rendering resolution-independent entities (such as 3D models) for viewing on a raster (pixel-based) device [4] such as a liquid-crystal display or CRT television inevitably causes aliasing artifacts mostly along geometric edges and the boundaries of texture details; these artifacts are informally called "jaggies". Anti-aliasing methods rectify such problems, resulting in imagery more pleasing to the viewer, but can be somewhat computationally expensive. Various anti-aliasing algorithms (such as supersampling) are able to be employed, then customized for the most efficient rendering performance versus quality of the resultant imagery; a graphics artist should consider this trade-off if anti-aliasing methods are to be used. A pre-anti-aliased bitmap texture being displayed on a screen (or screen location) at a resolution different than the resolution of the texture itself (such as a textured model in the distance from the virtual camera) will exhibit aliasing artifacts, while any procedurally defined texture will always show aliasing artifacts as they are resolution-independent; techniques such as mipmapping and texture filtering help to solve texture-related aliasing problems.

Volume rendering

Volume rendered CT scan of a forearm with different colour schemes for muscle, fat, bone, and blood.

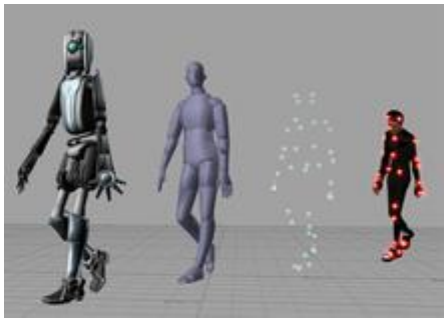
Volume rendering is a technique used to display a 2D projection of a 3D discretely sampleddata set. A typical 3D data set is a group of 2D slice images acquired by a CT or MRI scanner.

Usually these are acquired in a regular pattern (e.g., one slice every millimeter) and usually have a regular number of image pixels in a regular pattern. This is an example of a regular volumetric grid, with each volume element, or voxel represented by a single value that is obtained by sampling the immediate area surrounding the voxel.

3D modeling

3D modeling is the process of developing a mathematical, wireframe representation of any three-dimensional object, called a "3D model", via specialized software. Models may be created automatically or manually; the manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. 3D models may be created using multiple approaches: use of NURBS curves to generate accurate and smooth surface patches, polygonal mesh modeling (manipulation of faceted geometry), or polygonal mesh subdivision (advanced tessellation of polygons, resulting in smooth surfaces similar to NURBS models). A 3D model can be displayed as a two-dimensional image through a process called 3D rendering, used in a computersimulation of physical phenomena, or animated directly for other purposes. The model can also be physically created using 3D Printing devices.

Computer animation



Example of Computer animation produced using Motion capture

Computer animation is the art of creating moving images via the use of computers. It is a subfield of computer graphics and animation. Increasingly it is created by means of 3D computer graphics, though 2D computer graphics are still widely used for stylistic, low bandwidth, and faster real-time rendering needs. Sometimes the target of the animation is the computer itself, but sometimes the target is another medium, such as film. It is also referred to as CGI (Computer-generated imagery or computer-generated imaging), especially when used in films.[5]

Virtual entities may contain and be controlled by assorted attributes, such as transform values (location, orientation, and scale) stored in an object's transformation matrix. Animation is the change of an attribute over time. Multiple methods of achieving animation exist; the rudimentary form is based on the creation and editing of keyframes, each storing a value at a given time, per attribute to be animated. The 2D/3D graphics software will change with each keyframe, creating an editable curve of a value mapped over time, in which results in animation. Other methods of animation include procedural and expression-based techniques: the former consolidates related elements of animated entities into sets of attributes, useful for creating particle effects and crowd simulations; the latter allows an evaluated result returned from a user-defined logical expression, coupled with mathematics, to automate animation in a predictable way (convenient for controlling bone behavior beyond what a hierarchy offers in skeletal system set up).To create the illusion of movement, an image is displayed on the computer screen then quickly replaced by a new image that is similar to the previous image, but shifted slightly. This technique is identical to the illusion of movement in television and motion pictures.

III . Applications

Applications of computer graphics into four main areas:

a. Display of information : Recently there has been great interest in problems of scientific visualization. Although researchers are now using supercomputers to solve formerly intractable problems in fields such as fluid flow and molecular biology ,they need new display techniques to interpret the results of analyzing the vast quantities of multidimensional data generated.

b. Design : Professions such as engineering and architecture are concerned with design. Although their applications vary ,most designers face similar difficulties and use similar methodologies. One of the principal characteristics of most design problems is the lack of a unique solution. Hence ,the designer will examine a potential design and then will modify it ,possibly many times ,in an attempt to achieve a better solution. Computer graphics has become an indispensable element in this iterative process.

c. Simulation :Some of the most impressive and familiar uses of computer graphics can be classified as simulations. Video games demonstrate both the visual appeal of computer graphics and our ability to generate complex imagery in real time. The insides of an arcade game reveal state-of-the-art hardware and software. Computer-generated images are also the heart of flight simulators ,which have become the standard method for training pilots. The savings in dollars and lives realized from use of these simulators has been enormous. The computer-generated images we see on television and in movies have advanced to the point that they are almost indistinguishable from real-world images.

d. User interfaces :The interface between the human and the computer has been radically altered by the use of computer graphics. Consider theelectronic office. The figures in this book were produced through just such an interface. A secretary sits at a workstation ,rather than at a desk equipped with a typewriter. This user has a pointing device ,such as a mouse,that allows him to communicate with the workstation. The display consists of a number of icons that represent the various operations the secretary can perform. For example ,there might be an icon of a mailbox that ,if pointed to and clicked on ,causes any electronic-mail messages to appear on the screen. An icon of a wastepaper basket allows the user to dispose of unwanted mail ,whereas an icon of a file cabinet is used to save letters or other documents.

IV. Virtual Reality

Virtual Reality is an enabling technology that has wide applications in training, product design, etc. Virtual reality (VR) technology is being used to resolve problems in real-world situations. The National Aeronautics and Space Administration (NASA) is using VR to train astronauts to repair the Hubble Space Telescope. Virtual Reality as a human centered interface technology."Virtual Reality is a way for humans to visualize, manipulate and interact with computers and extremely complex data."This technology is more seen like something magical, with endless possibilities. The reality is quite an other story. The constraints that we must face are numerous .

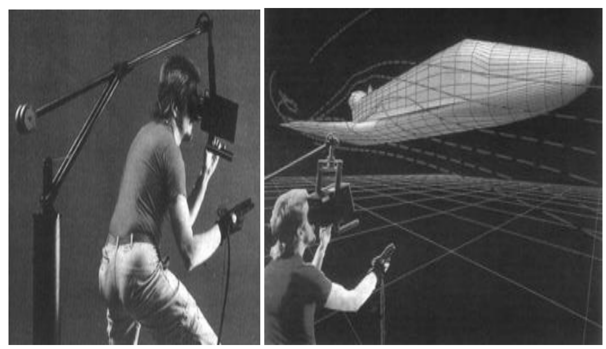
Levels of immersion in VR systems:

In a virtual environment system a computer generates sensory impressions that are delivered to the human senses. The type and the quality of these impressions determine the level ofimmersion and the feeling of presence in VR. Ideally the high-resolution, high-quality andconsistent over all the displays, information should be presented to all of the user'ssenses [Slat94]. Moreover, the environment itself should react realistically to the user'sactions. The practice, however, is very different from this ideal case. Many applicationsstimulate only one or a few of the senses, very often with low-quality and unsynchronizedinformation. We can group the VR systems accordingly to the level of immersion they offer to the user (compare with [Isda93, Schw95]):

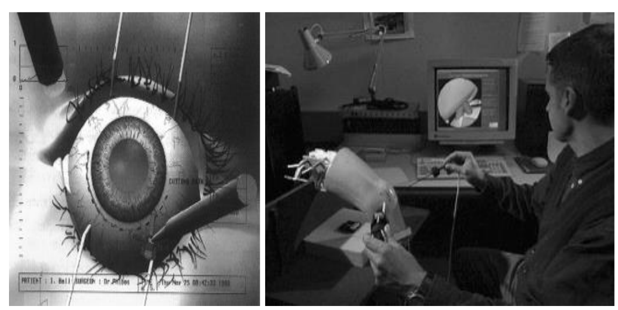
• Desktop VR – sometimes called Window on World (WoW) systems. This is thesimplest type of virtual reality applications. It uses a conventional monitor to display the image (generally monoscopic) of the world. No other sensory output is supported.

• Fish Tank VR – improved version of Desktop VR. These systems support headtracking and therefore improve the feeling of "of being there" thanks to the motion parallax effect. They still use a conventional monitor (very often with LCD shutter glasses for stereoscopic viewing) but generally do not support sensory output.

• Immersive systems – the ultimate version of VR systems. They let the user totallyimmerse in computer generated world with the help of HMD that supports a stereoscopic view of the scene accordingly to the user's position and orientation. These systems maybe enhanced by audio, haptic and sensory interfaces.



Exploration of airflow using Virtual Wind Tunnel developed at NASA Ames:(a) outside view, (b) inside view [6]



VR in medicine: (a) eye surgery , (b) leg surgery .

The use of flight simulators has a long history and we can consider them as the precursors oftoday's VR. First such applications were reported in late 1950s [7], and were constantlyimproved in many research institutes mainly for the military purposes [8]. Nowadaysthey are used by many civil companies as well, because they offer lower operating costs thanthe real aircraft flight training and they are much safer (see fig. 1.3.4.1). In other disciplines where training is necessary, simulations have also offered big benefits. Therefore they wereprosperously applied for determining the efficiency of virtual reality training of astronauts byperforming hazardous tasks in the space [9]. Another applications that allow training ofmedicine students in performing endosurgery [10], operations of the eye and of the leg were proposed in recent years (see fig.). And finally avirtual baseball coach has a big potential to be used in training and in entertainment.

VI. Conclusions

Computer graphics have changed the last fifty or sixty years, drastically. Now in a day and age where most people have their own PC (personal computer) or access to one, we all know just some of the ways in which we can generate computer graphics. Computer graphics entails more than software and hardware used to create pictures, it is also created using theories that are related to how we perceive things. One theory used when creating an animated series of images is how many different frames there should be in one second in order for humans to perceive these images as a fluid motion. Virtual Reality is arguably the next footstep towards a modern/post-modern era of development.. With the ability to save lives, act as a medium for business development and confrontations, and provide its users with endless hours of entertainment, learning, and discovery, the world should be pushing for an increased presence of this product, just the same as it did in the 1990's. This time around, our technology will have come far enough to support the needs for these devices and will begin implementing virtual reality within homes, medical centers, and offices.

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