ABSTRACT

The use of high-level, three-dimensional (3D) graphics modeling and animation systems has historically been used almost exclusively by graphic arts and the broadcast industry. A new wave of usage is emerging from several different, relatively unrelated applications with a need to create realistic 3D images for visualization. With this technology, designers and engineers are able to promote a better understanding of ideas and processes. The introduction of powerful, low-cost 3D workstations makes this type of product more affordable by a broader base of users. NeoVisuals™ software is a high-level, interactive, general purpose 3D system that adapts to specific applications through the use of available features and options.

INTRODUCTION

In the early days of computer-aided design, the most one could hope for was a wire frame drawing that showed a skeleton as if it were outlined by wires. As graphics technology has evolved, development work concentrated on making the object more realistic. The addition of opaque colors helped, but surfaces with curves still appeared as a series of patches. Newer approaches have been perfected that produce models with smoother curved surfaces and more accurate colors. Photo-realistic models (with several textures, and transparent and reflective surfaces) are beginning to appear on powerful workstations. Computers originally intended to be massive data repositories are now capable of actually representing graphic images. Spread sheets performed what-if scenarios for numbers; 3D graphics can do the same what-if scenarios for visualizing phenomena.

What qualifies a graphic image to be called 3D? An object can be represented in two dimensions, but with a fixed perspective, just the way that painters have worked since the Renaissance. However, because the image cannot be viewed from all angles, it lacks true depth. If someone wanted to actually look at the side of an object, the designer or artist would have to draw an entirely new image from scratch. True 3D can show a smooth, solid object moving in time, or can even view an image at all angles. For example, a statistician may want to interactively view a surface from several perspectives before producing output, or a scientist may want to illustrate the interaction of very tiny things like molecules or bacteria. A graphic artist may want to add depth and heighten the impact of a standard data-driven business graph by adding a sense of depth, lighting, shadows, textures, and backgrounds. With true 3D, the user is no longer a painter of flat surfaces, but a sculptor.

Many systems claim to be 2 1/2-D, or pseudo 3D, but if the object can't be moved in all directions, it's not 3D. SAS Institute Inc. has foreseen a growing demand for high-level, interactive graphics that provide true 3D perspective modeling, high quality rendering, and animation. In order to satisfy this need, the Institute acquired the 3D computer graphics and animation software from Neo-Visuals, Inc., based in Toronto, Canada. This software, named NeoVisuals, lets users generate photo-realistic images for applications ranging from simple business graphics to CAD models, architectural renderings, and sophisticated video animation.

NEOVISUALS SOFTWARE PRODUCT OVERVIEW

NeoVisuals software is a device-independent, three-dimensional geometric modeling, graphics, and animation system. It integrates modeling, rendering, and animation into a single, menu-, or command-driven system. The software is divided into four components: Base, Animation, Spline Modeler, and Font Editor.

NEOVISUALS BASE

The NeoVisuals Base system is comprised of a modeler and a renderer. The modeler lets you create two- and three-dimensional figures using both polygon and surface modeling techniques. To create proper looking solid objects, you define them as surfaces, rather than just edges. The simplest type of surface definition is the polygon. A polygon is a geometric figure bounded by lines or arcs. Polygons are used to construct the geometry of an object. This continuous array of polygons is also called a polygonal mesh. When rendered,
polygons are filled and shaded to represent an infinite variety of surfaces. NeoVisuals software can also work with open or closed figures. You begin drawing a two-dimensional form by joining points with lines and arcs, and then specify a third dimension graphically. Or, using the modeling tools, you can quickly transform a simple flat figure into an impressive three-dimensional object. A transformation is a command that allows you to change the position, orientation, or shape of a figure in the three-dimensional world. Using NeoVisuals software, you can modify the geometry of the object any way you want. You can twist it, taper it, rotate it, and explode the component items, or you can extrude your model along a continuous path. An extrude produces volume by creating sides as you sweep a figure or an object through space. For example, you can create a cube from a square, or a sphere from an arc.

Once your model has a shape, you can describe its surface characteristics. One of the most elementary characteristics of a surface is its color. In the simplest example, an object can have a single, uniform color. To select the color of an object with NeoVisuals software, you use a color palette and six color adjustment sliders. For more realistic effects, you can select a predefined material (like glass or steel) from the Materials Menu. If you select a material, NeoVisuals software sets all of the sliders to preassigned values, which automatically simulates the characteristics of the material. Then, you can then use the sliders for fine-tuning. There are sliders that control the primaries Red, Green, and Blue, as well as the attributes Lightness, Saturation, and Hue.

Another important aspect of a surface is how it interacts with light. The reflectivity of a surface is determined. Is it diffuse or shiny? Is it transparent? NeoVisuals software provides controls that can adjust a surface’s reflectance, specularity (smoothness), polished, transparency, and rolloff. Rolloff controls the rate at which a transparent object becomes opaque as light hits the surface. You can also determine whether your item will cast a shadow on another item.

The texture of a surface can be described using a technique called texture mapping. A two-dimensional mapped pattern can be chosen from the pattern library, created by you, or scanned in from film or video. The NeoVisuals software then maps this texture onto a selected surface, as if you were wrapping it with plastic wrap. You can also create a more three-dimensional look to your surface by using a feature called bump mapping.

This type of surface creates a bumpy surface, like that of a golf ball. Reflection, or environment mapping, directs models in a scene to reflect an image or pattern in the plotted environment. The plot environment is given an image pattern that will only be visible as a reflection on a figure or object.

As you continue, your model is placed into a scene, much the way the director of a play sets the aspects of the stage setting. With NeoVisuals software’s light controls, you can specify realistic lighting effects. Choosing globe, spot, parallel, or bar lights, you can place up to thirty-two lights at any location in your scene. A globe light provides illumination in all directions; spot lights illuminate from a particular direction; parallel lights simulate a distant light source, such as the rays of the sun; bar lights provide a look similar to a fluorescent tube. Multiple-colored light sources, placed at any location in the scene, illuminate the model from any angle, creating highlights and shadows. You can create cutaway views of the objects and view the same scene from different angles.

Rendering enables you to view your model with all its attributes. While you are creating your model, you can view the shapes you create and the changes that you make to them, but you cannot see the effects of color, lights, background, and so on, until you render the scene. The NeoVisuals renderer allows you to choose within a range of styles -- from a quick wireframe view to hidden line, flat shaded, or fully shaded scan-line.

NEOVISUALS SPLINE MODELER

The Spline Modeler meets the needs of designers who need to create models with complex curved surfaces, such as automobiles. This type of surface is also called a patch, which is a parametric description of a curved surface between four curves edges. Patches can be very efficient. You can represent them with fewer points, and an array of them can be joined into a smooth mesh without their boundaries being apparent. Achieving a similar appearance with polygons requires significantly more polygons. The interactive b-spline modeler uses industry-standard, Non-Uniform Rational B-Splines (NURBS). These powerful NURBS are the most accurate, flexible, and portable of all spline types. You can rotate an object around any axis, produce linear extrusions in any direction, trace a curve along a path, and connect spline curve contours. Then, as a sculptor works with clay, you can modify surfaces by molding and trimming.
NEOVISUALS ANIMATION

In computer graphics, animation can be defined as changing a scene or model over a period of time. Animation means joining different stationary pictures to produce the appearance of motion. Each separate picture is called a frame. NeoVisuals software allows you to create an animation sequence with an unlimited number of frames. You do not need to create all of the consecutive, separate frames in order to have an animated sequence. Instead, you create only a few selected frames, called keyframes, that are appropriately spaced throughout the frame range. The system automatically creates the in-between frames that join the keyframes together. You edit your keyframes by adjusting the animation parameters. Frames shown in the animation window in sequential order are displayed by adjusting the frame slider.

The Animation module gives you unlimited control over the motion of an item. Items can be figures, objects, light sources, or the camera. Also, NURBS patches and text can be animated by converting them to polygon representations, such as figures or objects. You can also animate a figure or object's transformation over time. An object can be programmed to follow virtually any path. You can control speed, direction, and acceleration at any point in time. If the path between two keyframe values is not what you want, you can adjust the path by using the NeoVisuals Function Editor.

Hierarchical object motion allows you to specify how transforming one member of a hierarchy affects other members of the hierarchy. For example, the motion of an arm can be articulated by grouping five objects: the hand, the forearm, the lower arm (hand and forearm), and the entire arm (hand, forearm, and upperarm). Each object can contain multiple axes for moves and rotations, allowing a full range of motion. Other features in the Animation module include scripting choreography, adjustable motion curves, path tracing, animated surface characteristics, and animated viewing parameters.

NEOVISUALS FONT EDITOR

The Font Editor allows you to manipulate existing fonts, as well as create your own. The three-dimensional text can have the same attributes as any other 3D object: colors, textures, reflections, and so on.

FILE TRANSFER.

IGES (Initial Graphics Exchange Standard) files store data in a universally accepted format, so that graphics data can be transported among different software packages. The IGES interface links NeoVisuals software to CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) systems with a common data format. The software's current IGES interface can do pre-processing, which reads and interprets the point, line, polygon, and NURBS surface entities for animation; and post-processing, which writes the polygon and spline surface entities into an IGES data file for analysis and manufacturing.

SAS/GRAPH® users can also take advantage of these exciting capabilities. When you output your graphs in a CGM format, that file can be imported into the NeoVisuals system. These graphics may be transformed into 3D formats, which can be enhanced with lights, textures, and photo-realistic backgrounds.

Once your scene is rendered, you send the finished image to different output devices to produce hardcopy, slides, or video. A shining example of the features of NeoVisuals software is SUGI 14's opening session video. You may find it hard to believe that what you see is a computer-generated model, and not photo film.

CONCLUSION

As you can see, a visualization system like NeoVisuals software is highly interactive. Because of this, the system requires 3D workstations, or 3D terminals linked to a general-purpose computer to achieve the maximum benefits. NeoVisuals software can be used in a command mode from a keyboard with quite effective output, but the real-time response is the trade-off. With the introduction of powerful workstations at a very attractive price over the last year, you may not have to make that sacrifice. NeoVisuals software currently runs on Silicon Graphics' Iris workstations, Digital Equipment Corporation's VAX™ family of computers, Hewlett-Packard's SRX series, Sun Microsystems' Series 3/260 CXP, and Cray supercomputers.

Using three-dimensional graphics modeling and animation by engineers and designers is becoming more common. Many companies are recognizing the need for more sophisticated methods with
which they can visualize concepts and analyze data, and present these concepts and data to management and customers. High-level graphics and animation are no longer just pretty pictures. Presentation with 3D graphics is becoming an integral part of many corporations. Applications include corporate communications, training, sales, electronic print/publishing, industrial and package design, medicine, science, education, and pharmaceuticals. These systems have become essential tools for business managers, engineers, scientists, and technical professionals.

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