COMPUTER SCIENCE

3D MODELING AND THE ROLE OF 3D MODELING IN OUR LIFE

[1]*Beknazarova Saida Safibullaevna*
[2]*Maxammadjonov Maxammadjon Alisher o'g'li*
[2]*Ibodullayev Sardor Nasriddin o'g'li*

[1]*Uzbekistan, Tashkent,*
Tashkent University of Informational Technologies, Senior Teacher
[2]*Uzbekistan, Tashkent,*
Tashkent University of Informational Technologies, student

Abstract. *In 3D computer graphics, 3D modeling is the process of developing a mathematical representation of any three-dimensional surface of an object (either inanimate or living) via specialized software. The product is called a 3D model. It can be displayed as a two-dimensional image through a process called 3D rendering or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices.*

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 modeling software is a class of 3D computer graphics software used to produce 3D models. Individual programs of this class are called modeling applications or modelers.

Key words: *3D, modeling, programming, unity, 3D programs.*

Nowadays 3D modeling impacts in every sphere of: computer programming, architecture and so on. Firstly, we will present basic information about 3D modeling.

3D models represent a physical body using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc. Being a collection of data (points and other information), 3D models can be created by hand, algorithmically (procedural modeling), or scanned.

3D models are widely used anywhere in 3D graphics. Actually, their use predates the widespread use of 3D graphics on personal computers. Many computer games used pre-rendered images of 3D models as sprites before computers could render them in real-time.

Today, 3D models are used in a wide variety of fields. The medical industry uses detailed models of organs; these may be created with multiple 2-D image slices from an MRI or CT scan. The movie industry uses them as characters and objects for animated and real-life motion pictures. The video game industry uses them as assets for computer and video games. The science sector uses them as highly detailed models of chemical compounds The architecture industry uses them to demonstrate proposed buildings and landscapes through Software Architectural Models. The engineering community uses them as designs of new devices, vehicles and structures as well as a host of other uses. In recent decades the earth science community has started to construct 3D geological models as a standard practice. 3D models can also be the basis for physical devices that are built with 3D printers or CNC machines.

A modern render of the iconic Utah teapot model developed by Martin Newell (1975). The Utah teapot is one of the most common models used in 3D graphics education.

Almost all 3D models can be divided into two categories.

- Solid - These models define the volume of the object they represent (like a rock). These are more realistic, but more difficult to build. Solid models are mostly used for nonvisual simulations such as medical and engineering simulations, for CAD and specialized visual applications such as ray tracing and constructive solid geometry
- Shell/boundary - these models represent the surface, e.g. the boundary of the object, not its volume (like an infinitesimally thin eggshell). These are easier to work with than solid models. Almost all visual models used in games and film are shell models.

Because the appearance of an object depends largely on the exterior of the object, boundary representations are common in computer graphics. Two dimensional surfaces are a good analogy for the objects used in graphics, though quite often these objects are non-manifold. Since surfaces are not finite, a discrete digital approximation is required: polygonal meshes (and to a lesser extent subdivision surfaces) are by far the most common representation, although point-based representations have been gaining some popularity in recent years. Level sets are a useful representation for deforming surfaces which undergo many topological changes such as fluids.

The process of transforming representations of objects, such as the middle point coordinate of a sphere and a point on its circumference into a polygon representation of a sphere, is called tessellation. This step is used in polygon-based rendering, where objects are broken down from abstract representations ("primitives") such as spheres, cones etc., to so-called meshes, which are nets of interconnected triangles. Meshes of triangles (instead of e.g. squares) are popular as they have proven to be easy to render using scan line rendering. Polygon representations are not used in all rendering techniques, and in these cases the tessellation step is not included in the transition from abstract representation to rendered scene.

Modeling process. There are three popular ways to represent a model:

1. Polygonal modeling - Points in 3D space, called vertices, are connected by line segments to form a Polygon mesh. The vast majority of 3D models today are built as textured polygonal models, because they are flexible and because computers can render them so quickly. However, polygons are planar and can only approximate curved surfaces using many polygons.
2. Curve modeling - Surfaces are defined by curves, which are influenced by weighted control points. The curve follows (but does not necessarily interpolate) the points. Increasing the weight for a point will pull the curve closer to that point. Curve types include non-uniform rational B-spline (NURBS), splines, patches, and geometric primitives
3. Digital sculpting - Still a fairly new method of modeling, 3D sculpting has become very popular in the few years it has been around. There are currently 3 types of digital sculpting: Displacement — which is the most widely used among applications at this moment, volumetric, and dynamic tessellation. Displacement uses a dense model (often generated by Subdivision surfaces of a polygon control mesh) and stores new locations for the vertex positions through use of a 32bit image map that stores the adjusted locations. Volumetric which is based loosely on Voxels has similar capabilities as displacement but does not suffer from polygon stretching when there are not enough polygons in a region to achieve a deformation. Dynamic tessellation Is similar to Voxel but divides the surface using triangulation to maintain a smooth surface and allow finer details. These methods allow for very artistic exploration as the model will have a new topology created over it once the models form and possibly details have been sculpted. The new mesh will usually have the original high resolution mesh information transferred into displacement data or normal map data if for a game engine.

The modeling stage consists of shaping individual objects that are later used in the scene. There are a number of modeling techniques, including:

- constructive solid geometry
- implicit surfaces
- subdivision surfaces

Modeling can be performed by means of a dedicated program (for example Cinema 4D, form Z, Maya, 3ds Max, Blender, Lightwave, Modo, solid Thinking) or an application component (Shaper, Lofter in 3DS Max) or some scene description language (as in POV-Ray). In some cases, there is no strict distinction between these phases; in such cases modeling is just part of the scene creation process (this is the case, for example, with Caligari true Space and Realsoft 3D).

Complex materials such as blowing sand, clouds, and liquid sprays are modeled with particle systems, and are a mass of 3D coordinates which have either points, polygons, texture splats, or sprites assigned to them.

3D photorealistic effects are often achieved without wireframe modeling and are sometimes indistinguishable in the final form. Some graphic art software includes filters that can be applied to 2D vector graphics or 2D raster graphic son transparent layers.

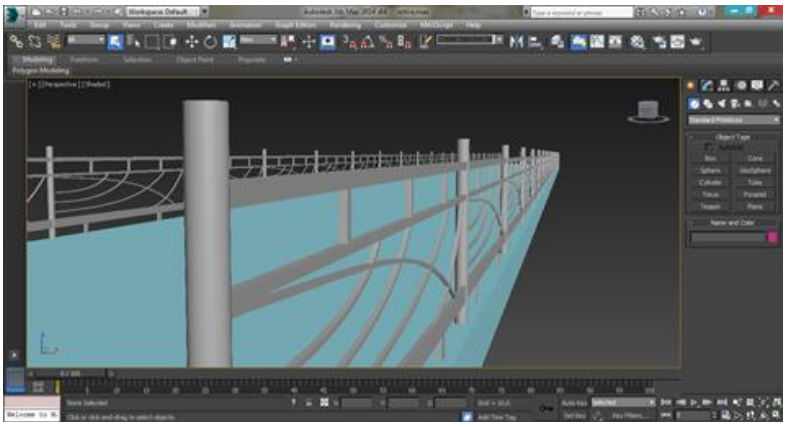

Fig.1. Program 3ds MAX

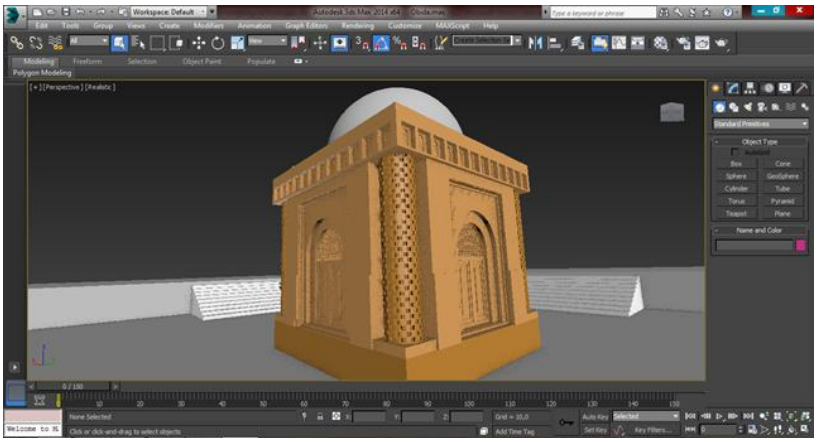

Fig.2. Creating 3D building

Advantages of wireframe 3D modeling over exclusively 2D methods include:

- Flexibility, ability to change angles or animate images with quicker rendering of the changes;
- Ease of rendering, automatic calculation and rendering photorealistic effects rather than mentally visualizing or estimating;
- Accurate photorealism, less chance of human error in misplacing, overdoing, or forgetting to include a visual effect.

Disadvantages compare to 2D photorealistic rendering may include a software learning curve and difficulty achieving certain photorealistic effects. Some photorealistic effects may be achieved with special rendering filters included in the 3D modeling software. For the best of both worlds, some artists use a combination of 3D modeling followed by editing the 2D computer-rendered images from the 3D model.

A large market for 3D models (as well as 3D-related content, such as textures, scripts, etc.) still exists - either for individual models or large collections. Online marketplaces for 3D content, such as Turbo Squid, The3DStudio, 3DExport, Creative Crash, CG Trader, Flat Pyramid, None CG, CG People Network, Design Connected and DAZ 3D, allow individual artists to sell content that they have created. Often, the artists' goal is to get additional value out of assets they have previously created for projects. By doing so, artists can earn more money out of their old content, and companies can save money by buying pre-made models instead of paying an employee to create one from scratch. These marketplaces typically split the sale between themselves and the artist that created the asset, artists get 40% to 95% of the sales according to the marketplace. In most cases, the artist retains ownership of the 3d model; the customer only buys the right to use and present the model. Some artists sell their products directly in its own stores offering their products at a lower price by not using intermediaries.

Over the last several years numerous marketplaces specialized in 3D printing models have emerged. Some of the 3D printing marketplaces are combination of models sharing sites, with or

without a built in e-com capability. Some of those platforms also offer 3D printing services on demand, software for model rendering and dynamic viewing of items, etc. Among the most popular 3D printing file sharing platforms are Shape ways, Pin shape, Thingiverse, 3DExport, CG Trader, Threeding, My Mini Factory and Grab CAD.

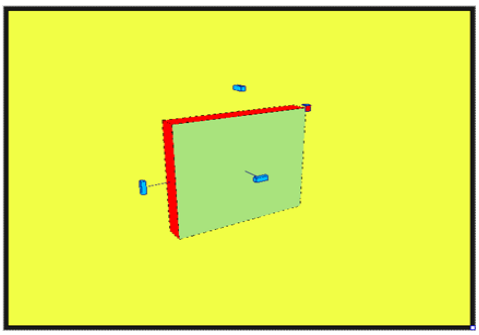

Fig.3. 3D modeling in other programs

3D modeling is used in various industries like films, animation and gaming, interior designing and architecture. They are also used in the medical industry for the interactive representations of anatomy. A wide number of 3D software are also used in constructing digital representation of mechanical models or parts before they are actually manufactured. CAD/CAM related software are used in such fields, and with these software, not only can you construct the parts, but also assemble them, and observe their functionality.

3D modeling is also used in the field of Industrial Design, wherein products are 3D modeled before representing them to the clients. In Media and Event industries, 3D modeling is used in Stage/Set Design.

We can use 3D modeling in programming(Picture 3). Also we can create virtual 3D buildings (*Fig.* 4).

Fig. 4. Creating 3D buildings with Unity program

So, 3D modeling is one of the most contributing sphere for modern technologies.

REFERENCES

1. Mark Djambruno “3D graphics and animation”
2. Фокс А., Пратт М. Вычислительная геометрия. Применение в проектировании и на производстве: Пер. с англ. - М.: Мир, 1982. - 304 с.
3. Голованов Н. Н. Геометрическое моделирование. - М.: Издательство Физико-математической литературы, 2002. - 472 с.
4. Иванов В.П., Батраков А.С. Трехмерная компьютерная графика /Под ред.