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## **ВИДЫ 3D-МОДЕЛИРОВАНИЯ И ТЕНДЕНЦИИ ЕГО РАЗВИТИЯ**

*Аннотация: статья посвящена ознакомлению с концепцией 3D-моделирования и основными ее видами. Рассматриваются вопросы развития 3D-печати и технологий в будущем. Также статья содержит информацию о роли 3D-моделирования в жизни людей.*

*Ключевые слова: 3D-моделирование, программы моделирования, приложения, тенденции развития.*

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## **TYPES OF 3D-MODELING AND IT'S DEVELOPMENT TRENDS**

*Abstract: the article is made for familiarization with 3D-modeling concept and main types of it. The themes of developing in 3D-printing and technologies in the future*

*are taken. This article contains the information about roles of 3D-modeling in people's lives.*

**Keywords:** *3D-modeling, programs of modeling, application, development trends.*

3D-modeling is based on huge mathematical dependencies and algorithms which were developed already in the beginning of 1960-s. But weak software did not allow to construct even the simplest 3D-models. The first mentions about three-dimensional objects appeared in 1963 when American aspirant Ivan Sutherland invented Sketchpad, where he was making simple 3D objects. Sketchpad became an innovator in the full application of the graphical user interface. Then in 1969 Ivan Sutherland and David Evans created the Evans & Sutherland program, which allowed to work with three-dimensional graphics quickly. Subsequent developers also made huge contributions in computer modeling. For example, the company Mathematics Application Group, Inc (MAGI) built 3D models on the basis of combining 25 figures and Triple-I combined triangles and squares. All organizations and their software innovations that are above made it possible to implement many digital and graphic ideas in the future.

#### *Types of 3D-modeling*

Today 3D models are found in entertainment sphere, advertising and marketing, surgery and industrial construction. There are many computer games, animation, samples of special devices and objects that were created with these digital technologies. The following types of 3D modeling are used to create three-dimensional models:

- Polygonal;
- Spline modeling;
- Solid modeling;
- 3D-sculpting;
- Industrial;
- 3D-bioprinting.



Pic. 1 [4]

Polygons – elements in the form of squares and triangles that are used to create 3D models of the polygon type. (Picture 1). Depending on the complexity of the three-dimensional object there are low poly (small number of polygons) and high poly models (a large number of polygons). A special feature of this type of modeling is getting final visual image, which is hollow inside (it is called render): a wallpaper on the desktop, animation in movies and cartoons. The most popular programs for polygon modeling are Autodesk 3Ds Max and Autodesk Maya. With these products most animation studios create their bestsellers that are well-remembered by the audience.

Another type of 3D modeling is spline (NURBS) modeling. It is based on a set of three-dimensional curves (so-called splines): arcs, spirals, circles, and other elements. Due to the flexibility of each spline people can recreate objects whose quality does not change while zooming. Programs for this type of modeling: Rhino 3D, T-Spline.

Solid modeling is used in 3D printing and it is the most reliable method of modeling. All the physical properties of the object can be reflected with this technology, the shell and internal volume are being worked out.

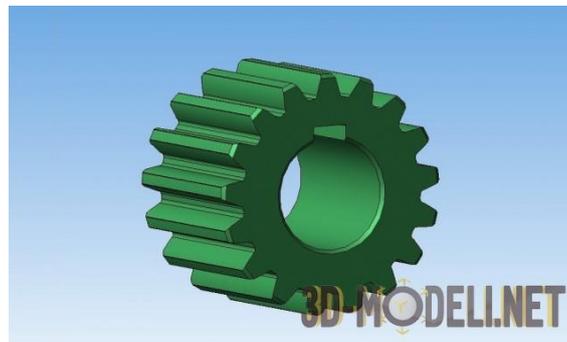
A solid is a closed area of space filled with «material». A solid body is characterized as a multilateral representation and history of its creation. A multilateral representation of a body is shown as a transparent or opaque volume whose borders consist of complex of lines and face surfaces [3].

3D-sculpting is an imitation of the process of «molding» a 3D model and deforming its polygonal grid with special tools – brushes (Picture 2) [1] Programs that represent this type of modeling are «ZBrush», «Sculptris», «Autodesk Mudbox», etc [1].



Pic. 2

Industrial modeling is a Computer-Aided Design (CAD) system. All objects in this modeling are full and they are built according to the profile + direction rule. It is used to create exact copies of items used in industry (Picture 3) [1].



Pic. 3

3D bioprinting is made to print organs which can replace poorly functioning human organs. Nowadays it is available to print ears, skin, and blood vessels. This technology is effective because, for example, on the basis of individual human cells people can recreate individual tissues and make research on the reaction of the human body to any treatment, including chemotherapy for cancer.

### *3D modeling in the future*

Through dozens of years the modelling will reach the largest scales. The professions of visualizer, modeler and animator are becoming the most popular on the labor market: in medicine, science, construction, education.

Additive technologies will play a big role in the future – 3D printing with layering of objects on the top of each other or with laser melting. This technology will be used

in the aerospace, automotive and medical industries. Several decades ago, only few people could use 3D printers, but now this technology becomes available to more and more people.

3D bioprinting is a perspective in additive technologies. It improves the methods of designing an artificial organ, and also considers the question of the most rational use of a particular material in this process. Scientists are developing technologies for printing almost all human organs, including bones, kidneys and heart (Picture 4).



Pic. 4 [2]

For such 3D modeling it is planned to take biomaterial, which will be incubated after printing until it is fully grown and filled with vital vessels. In addition, it will be possible to create artificial food products.

In the entertainment industry a new generation of 3D photo booths will appear, and «volumetric photoshop» will gain popularity.

It is worth adding that technologies in the XXI century will develop rapidly and 3D modeling in all its forms will also develop. Humanity has to see a lot of new things that will undoubtedly change our life beyond recognition.

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