

## COMPUTER GRAPHICS

Вінницький національний технічний університет

**Анотація:** У статті розглядається поняття комп'ютерної графіки, її основні різновиди та використання у цій галузі в сучасному світі.

**Ключові слова:** комп'ютерна графіка, дизайн, програми, рисунки, малювати, формат, данні, наука.

**Abstract:** The article deals with the conception of computer graphics, it's main types and use in this sphere in modern world.

**Keywords:** computer graphics, design, programs, pictures, drawings, format, data, science.

Computer graphics are pictures and films created using computers. Usually, the term refers to computer-generated image data created with the help of specialized graphical hardware and software. It is a vast and recently developed area of computer science [1].

Some topics in computer graphics include user interface design, sprite graphics, vector graphics, 3D modeling, shaders, GPU design, implicit surface visualization with ray tracing, and computer vision, among others.

Computer graphics is responsible for displaying art and image data effectively and meaningfully to the consumer. It is also used for processing image data received from the physical world. Computer graphics development has had a significant impact on many types of media and has revolutionized animation, movies, advertising, video games, and graphic design in general[2].

### Raster and vector graphics

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 Paint-Shop Pro are based on raster graphics, while more sophisticated programs such as CorelDRAW, AutoCAD, and Adobe Illustrator use vector graphics. Let's see the different between them.

### Raster graphics

Stare hard at your computer screen and you'll notice the pictures and words are made up of tiny colored dots or squares called pixels. The example of raster graphic picture is shown on the picture 1. Most of the simple computer graphic images we come across are pixelated in this way, just like walls are built out of bricks. The first computer screens, developed in the mid-20th century, worked much like televisions, which used to build up their moving pictures by "scanning" beams of electrons (tiny charged particles inside atoms, also called cathode rays) back and forth from top to bottom and left to right—like a kind of instant electronic paintbrush. This way of making a picture is called raster scanning and that's why building up a picture on a computer screen out of pixels is called raster graphics.

The most popular raster graphic editors are Adobe ImageReady, Adobe LiveMotion, Adobe Photoshop, Autodesk SketchBook Pro, ArtRage. Common raster image file extensions include .BMP, .TIF, .JPG, .GIF, and .PNG.



Picture 1 – the example of raster graphics

## Vector graphics

There's an alternative method of computer graphics that gets around the problems of raster graphics. With raster graphics, you make a drawing of a house by building it from hundreds, thousands, or millions of individual pixels; importantly, each pixel has no connection to any other pixel except in your brain. With vector graphics, you might draw a rectangle for the basic house, smaller rectangles for the windows and door, a cylinder for the smokestack, and a polygon for the roof. Drawing with straight lines and curves instead of individual dots means you can produce an image more quickly and store it with less information: you could describe a vector-drawn house as "two red triangles and a red rectangle (the roof) sitting on a brown rectangle (the main building). You can see the vector image of house described on the picture 2. 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. That's how computer programs can scale fonts to different sizes without making them look all pixelated and grainy [1].

People often choose Adobe Fireworks, Adobe FreeHand, Adobe Illustrator, Affinity Designer, Corel Draw for working with vector pictures. The most useful vector graphics formats are:

- "SVG" — Scalable Vector Graphics XML format (.svg)
- "DXF" — AutoCAD drawing exchange format (.dxf)
- "WMF", "EMF" — Windows metafile and enhanced metafile formats
- "EPS" — Encapsulated PostScript (.eps)
- "PDF" — Adobe PDF format (.pdf)[3]



Picture 2 – the example of vector graphics

## 3 D Graphics

3 D graphics — 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. 3D computer graphics are often referred to as 3D models. There are differences: a 3D model is the mathematical representation of any three-dimensional object. A model is not technically a graphic until it is displayed. A model can be displayed visually as a two-dimensional image through a process called 3D rendering or used in non-graphical computer simulations and calculations. With 3D printing, 3D models are similarly rendered into a 3D physical representation of the model, with limitations to how accurate the rendering can match the virtual mode. The 3D illustration is imaged on the picture 3 [4].



Picture 3– the example of 3D graphics

3D computer graphics software produces computer-generated imagery (CGI) through 3D modeling and 3D rendering or produces 3D models for analytic, scientific and industrial purposes. The most popular 3D graphic builders are 3D MAX, AutoCAD, 3D Slash, Clara.io and Mud-box. They also use stl, 3ds, ai, abc, ase, asm formats [5].

## Fractal graphics

Fractals are very complex pictures generated by a computer from a single formula. Fractals are the kind of shapes we see in nature. We can describe a right triangle by the Pythagorean theorem, but finding a right triangle in nature is a different matter altogether. We find trees, mountains, rocks and cloud formations in nature, but what is the geometrical formula for a cloud? How can we determine the shape of a dollop of cream in a cup of coffee? Fractal geometry, chaos theory and complex mathematics attempt to answer questions like these. Science continues to discover an amazingly consistent order behind the universe's most seemingly chaotic phenomena. The example of fractal effigy is depicted on picture 4.

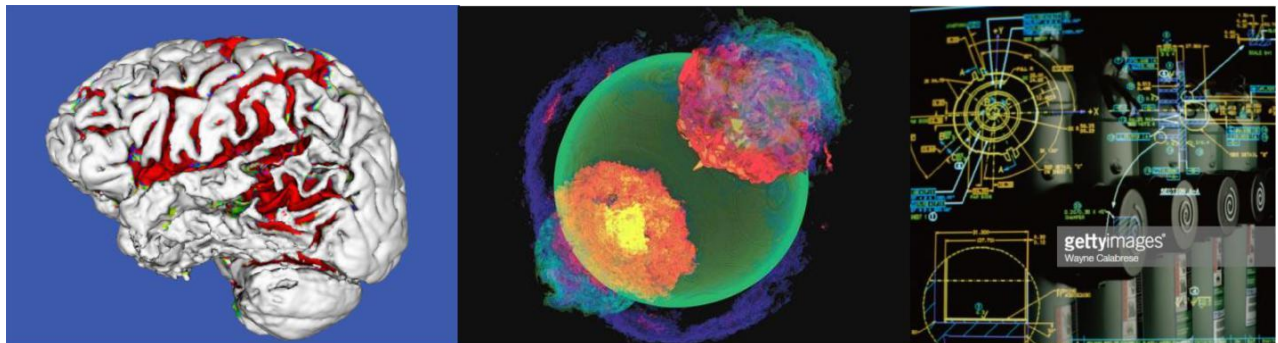
Mathematicians have attempted to describe fractal shapes for over one hundred years, but with the processing power and imaging abilities of modern computers, fractals have enjoyed a new popularity because they can be digitally rendered and explored in all of their fascinating beauty [6].



Picture 4– the example of fractal graphics

### What is computer graphics used for?

Obvious uses of computer graphics include computer art, CGI films, architectural drawings, and graphic design—but there are many non-obvious uses as well and not all of them are "artistic." Scientific visualization is a way of producing graphic output from computer models so it's easier for people to understand. Computerized models of global warming produce vast tables of numbers as their output, which only a PhD in climate science could figure out; but if you produce a speeded-up animated visualization—with the Earth getting bluer as it gets colder and redder as it gets hotter—anyone can understand what's going on. Medical imaging is another good example of how graphics make computer data more meaningful. When doctors show you a brain or body scan, you're looking at a computer graphic representation drawn using vast amounts of data produced from thousands or perhaps even millions of measurements. You can see the example of using computer graphic in scientific visualization on the picture 5. The jaw-dropping photos beamed back from space by amazing devices like the Hubble Space Telescope are usually enhanced with the help of a type of computer graphics called image processing; that might sound complex, but it's not so very different from using a graphics package like Google Picasa or PhotoShop to touch up your holiday snaps) [7].



Picture 5– the example of using computer graphic in scientific visualization

As a result, we see and use computer graphics in our everyday life. It's include everything from the simple pictures till scientific imagines. It began being popular since people start using World Wide Web. The progress-ing of computer graphics gives people opportunities to make 3D models in different industries. Of course, com-puter graphics is being useful in movie productions more than other deals. Computer graphics make our future brighter and modern

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### ***Хазівалієва Ірина Ігорівна***

студентка 2 курсу,  
факультету ІТКІ, групи 2 КН-17б,  
Вінницький національний технічний університет  
irahaz@ukr.net

### ***Столяренко Оксана Василівна,***

кандидат педагогічних наук,  
доцент кафедри іноземних мов  
Вінницького національного технічного університету

### ***Khazivalieva I.***

2nd year student,  
Faculty of ITCI, group 2 CS-17B,  
Vinnitsa National Technical University  
irahaz@ukr.net

### ***O. Stoliarenko***

candidate of pedagogical sciences,  
Associate Professor of the Department of Foreign Languages  
Vinnitsia National Technical University  
Oksanny-81@ukr.net