

COMPARATIVE ANALYSIS OF 3D PRINTING TECHNOLOGIES FOR THE PROTOTYPING OF QUADCOPTER PARTS

We are faced with the task of manufacturing the part of the beam of the quadcopter of optimal design.

The classic method of manufacturing a component is based on the "subtraction/difference". Take care of the desired material. From the workpiece, cut off the unwanted material to get the part. Nowadays new technologies of manufacturing of details are included. New technologies include additive technologies (Additive Fabrication (AF) or Additive Manufacturing (AM)). Additive technology is based on the creation of a component through its layer-layer synthesis. The item /product is created from scratch. The material is added layer by layer.

Together with additive technologies, the term "rapid prototyping" (Rapid Prototyping) is common. Developers of the first technologies of 3D printing considered their use for prototypes and models of products. Nowadays, modern additive technologies can print a high-quality finished product.

The more famous name of additive technology is 3D printing. The name came from the printing of images on flat materials (paper, film) using an inkjet printer. [1]

The following factors have contributed to the new technology: the growing popularity of 3D printing, the availability of desktop 3D printers, the development of reliable software for design and modeling, the introduction of new reliable materials.

3D printing technology is becoming widespread. Users adapt it to different needs. 3D printing technology is developing to meet socio-technical and infrastructural issues. [2]

Creating a 3D component consists of three stages: image creation / modeling, post-processing image, 3D printing.

Modeling an image is a very important stage in the production. The quality of the 3D component directly depends on the quality of the data. Post-processing images split the image into segments and then apply a grid. For this stage there is a special software. The contours of a segmented region of interest can be converted computationally into 3d TriangleMesh. The grid data can be further processed using CAD (Computer-Aided Design) software. This may include automatic grid optimization or manual geometry modification. After these two steps, data is sent to a 3D printer. Third stage 3D printing. At this stage, three-dimensional figures are printed on a digital 3D model. The machine reads the data from the CAD drawing and sequentially lays out layers of liquid, powder or sheet material, and thus accumulates the model from a series of cross-sections. These layers create the final shape. The advantage of additive manufacturing is its ability to create almost any complex form or geometric feature. [3]

A 3D printer is a peripheral device for printing 3D shapes on a digital 3D model. Printing is carried out by way of spherical expansion of a bulk physical object.

The 3D printer has the following components:

- body;
- extruder - printing head;
- actuator extruder;
- printed platform - the surface on which the object is printed;
- control module;
- power supply unit.

The publications [2,4,5] concerning 3D printing technologies were analyzed. One can conclude that the most commonly used 3D printing technologies are SLA, SLS and FDM.

SLA (Stereolithography, laser stereolithography) - A three-dimensional figure is formed from a liquid photopolymer, which hardens under the influence of a laser.

The advantages of SLA technology are as follows: high print accuracy; manufacturing of complex models with lots of small parts; possibility to get large and heavy goods (150x75x55cm, up to 150 kg); small amount of waste; the simplicity of finishing (polishing), which in many cases is not required.

The disadvantages of SLA technology are as follows: a small print speed; a large proportion and size; low durability of created objects; high cost of printer and consumables; limited range of materials; color printing is not provided.

SLS (selective laser sintering) - the formation of a three-dimensional object made of powder material, which melts under the influence of a laser.

Advantages of SLS technology: a wide range of materials (plastic, metal, foundry wax, ceramics, glass); the opportunity to get complex objects; suitability for small-scale production; painting is possible; minimal finish; higher print speeds than SLA printers; unlike other technologies, does not require supporting structures when printing products of complex configuration (the role of support is played by the powder itself).

Disadvantages of SLS technology: requires a sealed chamber and a powerful laser; small size of received objects (up to 55x55x75cm); the resulting products require finishing; less precision compared to SLA devices; unsuitability to work at home.

FDM (Fused Deposition Modeling, FFF, layered surfacing) - the formation of a three-dimensional object made of plastic or metal yarn. Household printers are provided with one extruder, and industrial - two or more. Printers with similar technology often meet.

Advantages of FDM technology: low cost of printer and consumables; compactness and small weight of the printer; good print quality; color printing; a wide range of materials (plastic, tin, various alloys and even chocolate).

Disadvantages of FDM Technology: Low Speed Printing; complexity with fixing an object on the desktop; the tendency of products to shrink (reduction of the size of the object after cooling); manufactured models require finish processing; great constraints in geometry; possible defects in printing; a large amount of waste. [6]

Given the popular 3D printing technology, we can conclude that SLS will be the optimum technology for printing of ray the quadcopter. Because the 3D printers of SLS technology have good print quality, the ability to print complex geometry and small parts, do not require post processing. But, despite all the benefits of having a

very high cost. SLA technology also has a high cost and has limitations in the need to create supporting designs and a small print area.

With FDM technology, designing 3D models for printing is limited and the creation of the component takes a lot of time due to the low speed of printing and long processing of the part. The main advantage is the presence of such a printer in our lab. FDM technology has low cost and a large selection of printing materials. Therefore, it is suggested to use FDM technology to print of ray the quadcopter.[1]

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