3D PRINTING TECHNOLOGY AND BUILDING THE 3D PRINTER

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ABSTRACT: *3D printing technology is a method of forming three-dimensional objects of arbitrary shape, created through an additive process that creates layers on top of each other. The technology is in constant development although it is capable of creating complex shapes avoiding most human errors . In the last decade 3D printing has become accessible to all consumers. Creating such a machine is not difficult and can be done with an average level of difficulty by anyone who can invest a relatively small amount of money. One can thus see the importance of this technology in the fields of construction, engineering and even medicine.*

KEY WORDS: 3D printer, Manufacturing methods

1.Introduction

3D printing technology is an additive process by which complex shapes are created by superimposing several layers on top of each other. The technology appeared in 1976 when the first ink printer appeared, which in 1984 had several adaptations until it reached printing with various materials created by Charles Hull. 3D printers went through a series of developments until 2009 when kits for creating such printers began to be introduced on the market**[4].**

The technology has come to be used in the field of construction, noting in an article dated December 22, 2019, an office building from the Arab Emirates in Dubai created by Apis Cor, this being built only by means of 3D printing technology[3]. This technology has also revolutionized medicine, for example, in early 2019 a team at ETH, led by PhD student Nicholas Cohrs, made what they say is the first artificial heart created from soft materials using a 3D printer[6]. Thus, the pumping mechanism works, thanks to silicone ventricles, which pump exactly like those of a real heart.. This technology is accessible at a minimum cost of 1000 lei for anyone who wants to enter this field with an average level of knowledge. The objective of this studio is to present the 3D printing technology and its capabilities for the industrial and medicinal revolution, but also to analyze and present the realization capabilities.

2. Current research

Nowadays the technology has become so accessible that they can be created and used at home by a relatively large number of people as a hobby. Printers have come to range from the smallest and most compact ones that can be carried in a small box to printers large enough to print entire buildings[2]. Templates for printed articles can be created independently or downloaded from the Internet.

When it comes to the printing process, we can easily say that a 3D object is created by building several layers of material, retains the desired shape after curing and has the typical properties of the material used. It is either filament or resin. 3D printers differ from each other in the printing process, as the following example method illustrates[5] :

- FDM (Fused Deposition Modeling) or FFF (Fused Filament Manufacturing): A type of polymer fused deposition modeling. Heat the filament to melt and extrude it. Based on the information in the print file, the head moves with the X and Y coordinates to reproduce the modeled object. In this

case, the platform it is built on is also mobile, moving in the Z direction and building layer by layer. The advantage of this technique is that it is efficient and fast, but it runs from the bottom up and is not suitable for models with too prominent parts.

- SLA (Stereolithography): Stereolithography is a fairly old system that uses a photosensitive liquid resin that hardens with a laser. The layers are then piled up to form a finished product. It has the same limitations as FDM, but creates objects with very smooth surfaces and lots of detail.- DLP (Digital Light Processing) – Digital Light Processing is a type of 3D printing similar to SLA, but with a light-curable liquid photopolymer. The result is a very high resolution and a robust object.

- SLS (Selective Laser Sintering): Selective laser sintering is similar to DLP and SLA, but uses powder instead of liquid. Used for printers with nylon, aluminum and other such materials. The laser attaches dust particles to form objects. Casting and extrusion can create parts that are difficult to manufacture.

-Support: Although the most popular printers are compatible with Windows, macOS and GNU / Linux, you should pay special attention if there are drivers for your system.

-Extra: Some printers include other features that can be interesting, such as LCD screens with process information, WiFi connectivity to connect them to a network, built-in cameras to be able to film the printing process, etc.

- Assembly and Disassembly: Many printers can be used out of the box (for beginners), but if you're into DIY, you can find inexpensive models that you can assemble piece by piece using kits.

There are many types of 3D printers, but not all of them are intended for use by consumers. When it comes to building a printer you need to consider your intended use, budget and desired features. It requires an investment to be able to make it but also some knowledge to be able to make an efficient printer.

2.1. ANET A8 3D printer, the difficulty of creating and examples of 3D printers

An ANET A8 3D printer was created for the demonstration. The printer has a printing capacity on a surface of 220 x 220 x 240mm.

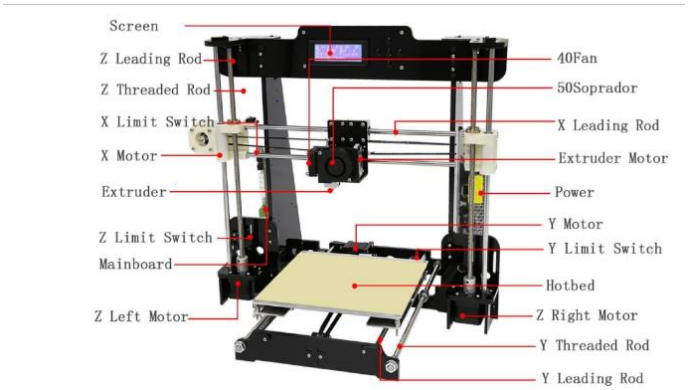

Fig. 1. ANET A8 3D printer

The printer provides the ability to learn printing technology. The printer can use filaments of the following types: PLA, WOOD, PVA, ABS, PP. Even if the kit is enough to create this model, an additional investment is required to optimize, ensure its integrity and functionality. Most printer upgrade components can be printed [8].

This printer is a good start for a person who wants to learn. New prototypes can be made from this. An example of a model that was created from the principle of the ANET A8 3D printer but with the idea of small size and transport capacity is the Positron V3, which is a compact printer that prints in contrast to the classic ones in reverse.

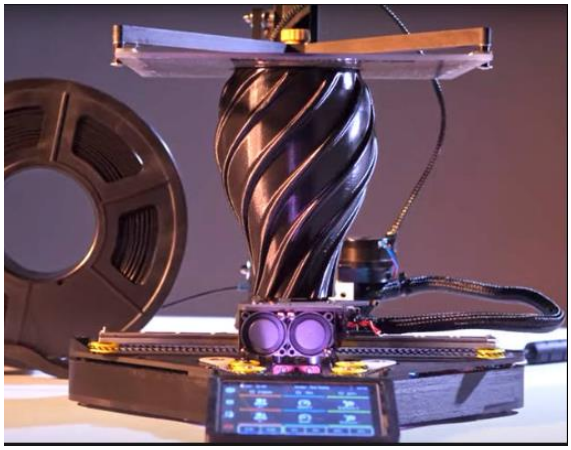

Fig.2. Positron V3

This model is proof of the innovative capacity of 3D printing, which can make parts in a short time wherever you need them.

The A8 printer uses various filaments but the most common is PLA, a biodegradable thermoplastic that is derived from renewable resources and has the ability to degrade into lactic acid. This material is easy to work with, so it works well for beginners. In addition, it is less prone to deformation and is available in translucent colors that glow in the dark. ABS filament provides a very strong and durable product at a low cost, as well as being light and semi-flexible. It can be used to design objects that need to withstand high temperatures, such as moving parts, electronic housings and toys.

An 3D printer is built in two steps. In the first stage, the basic building blocks are organized into functional assemblies and subassemblies. In a second step, the latter are assembled and interconnected on a 3D printer. Most parts are ordered due to lack of resources to make them by hand. The base frame is the "foundation" assembly of the 3D printer, which in addition to housing the structural elements of the frame at the bottom of the 3D printer, also contains a fully functional Y-axis along with the print table. The frame must be solid and the axles must have as little resistance as possible to ensure the printing speed. The axles are made of aluminum bars that have a motor in the ends on which is placed a band that drives the axle.

On the X-axis is the printhead that heats the filament and layers it on top of each other. It is operated with the help of a belt and a motor that makes it move on the axis. The X-axis is held on either side by the Z-axis which gives it vertical mobility.

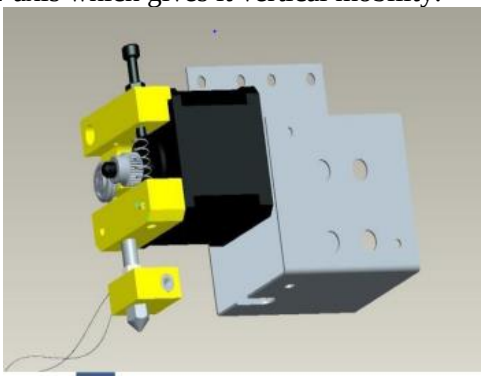

Fig. 3. Printer head.

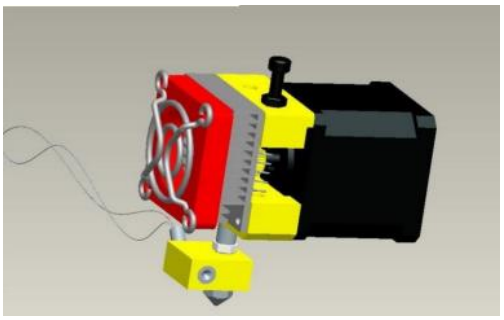

Fig.4. Printer head fan.

The print head contains a fan that provides effective cooling to slow down its overheating.
This whole assembly is controlled by a control board that controls the speed of the motors, the temperature of the print head and allows the user to insert an SD card with 3D models to be printed .

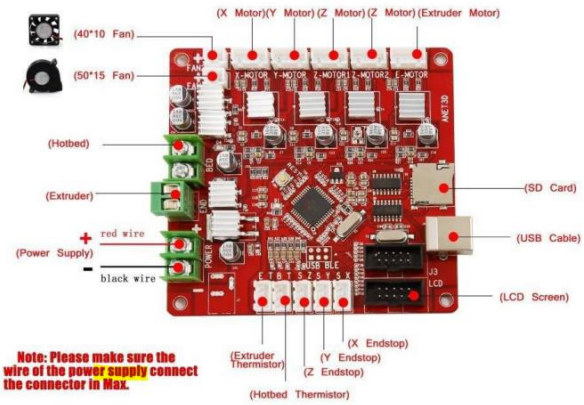

Fig. 5. MotherBoard.

The printer screen allows the selection of temperatures, the calibration of the axes and the printing surface, and the choice of the desired object to be printed.

For a beginner who wants to understand the structure of a 3D printer but doesn't want to invest a huge amount of money, it's a good start, but some upgrades are needed to ensure user safety. Due to the low price, the printer has little frame stability and lacks some of the fuses of a normal printer.

Normally a printer needs minor user intervention but due to the lack of fuses and normal optimizations it needs to be monitored much more than a classic printer. These things can be fixed by creating supports that will strengthen the frame that can be achieved with the help of the printer, investing in sensors that analyze the temperature of the print head and stop the entire printer when it reaches a critical temperature.

3. Conclusions

3D printers can be built from readily available and affordable components and materials. The assembly process is simple and requires some knowledge, attention and a little skill. Once built, the 3D printer is both a means of production for various objects and a stimulus for research and innovation, in order to diversify its functionalities and increase its performance or create new models, but also the ability to innovate the field of construction but also of medicine.

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