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3D Printing
Making the Digital Real

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Abstract

3D printing is quickly expanding field, with the popularity and uses for 3D printers growing every day. 3D printing can be used to prototype, create replacement parts, and is even versatile enough to print prostheses and medical implants. It will have a growing impact on our world, as more and more people gain access to these amazing machines.[1] In this article, we would like to attempt to give an introduction of the technology. 3Dimensions printing is a method of converting a virtual 3D model into a physical object. 3D printing is a category of rapid prototyping technology. 3D printers typically work by printing successive layers on top of the previous to build up a three dimensional object. 3D printing is a revolutionary method for creating 3D models with the use of inkjet technology.[7]

Keywords: 3D printing technology, 3D printer, Advance Printing, Rapid Prototyping.

Introduction

3D printing is also known as desktop fabrication or additive manufacturing; it is a prototyping process whereby a real object is created from a 3D design. The digital 3D-model is saved in STL format and then sent to a 3D printer. The 3D printer then prints the design layer by layer and forms a real object [4]. 3D printing is a fast-developing and cost-effective form of rapid prototyping. 3D Printing technology based upon common inkjet desktop printers where multiple jets deposit the print material layer after layer based on the 3D CAD data. [6] The process of "printing" a three-dimensional object layer-by-layer with equipment. 3D printing makes it possible to make a part from scratch in just hours. It allows designers and developers to go from flat screen to exact part. 3D printing can provide great savings on assembly costs because it can print already assembled products. With 3D printing, companies can now experiment with new ideas and numerous design iterations with no extensive time or tooling expense. They can decide if product concepts are worth to allocate additional resources. 3D printing could even challenge mass production method in the future. 3D printing is going to impact so many industries, such as automotive, medical, business & industrial equipment, education, architecture, and consumer-product industries. [4]

History

The inception of 3D printing can be traced back to 1976, when the inkjet printer was invented. In 1984, adaptations and advances on the inkjet concept morphed the technology from printing with ink to printing with materials. In the decades since, a variety of applications of 3D printing technology have been developed across several industries.[2] With all of its recent headlines and technological leaps, additive manufacturing can feel like a very new field. But in fact, 3-D printing has been slowly evolving in labs and in the market since Chuck Hall invented stereo lithography back in 1986 with his company, 3D Systems.In the 27 years since, additive manufacturing has evolved from Hall's original concept into a thriving, diverse collection of techniques and technologies that fall under the "3-D printing" umbrella. These include fused deposition modelling, ink jet printing and laser sintering – technologies that have brought the power of 3-d printing everywhere from the home workshop to the factory floor.[3] In September, 2011 - Vienna University of Technology developed a smaller, lighter and cheaper printing device.This smallest 3D printer weighed around 1.5 kilograms, it costs around 1200 Euros.[4]

Process of 3D Printing

The basic process of 3D printing are defined and simplified in the following 5 steps:

CAD Model Creation: First, the object to be built is modeled using a Computer-Aided Design (CAD)

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software package. Solid modelers, such as Pro/ENGINEER, tend to represent 3-D objects more accurately than wire-frame modelers such as AutoCAD, and will therefore yield better results. The designer can use a pre-existing CAD file or may wish to create one expressly for prototyping purposes. This process is identical for all of the RP build techniques. [7]

Conversion to STL Format: The various CAD packages use a number of different algorithms to represent solid objects. To establish consistency, the STL (stereo lithography, the first RP technique) format has been adopted as the standard of the rapid prototyping industry. The second step, therefore, is to convert the CAD file into STL format. [7]

Slice the STL File: In the third step, a pre-processing program prepares the STL file to be built. Several programs are available, and most allow the user to adjust the size, location and orientation of the model. The pre-processing software slices the STL model into a number of layers from 0.01 mm to 0.7 mm thick, depending on the build technique. The program may also generate an auxiliary structure to support the model during the build. Supports are useful for delicate features such as overhangs, internal cavities, and thin-walled sections. Each RP machine manufacturer supplies their own proprietary pre-processing software. [7]

Layer by Layer Construction: The fourth step is the actual construction of the part. Using one of several techniques (described in the next section) RP machines build one layer at a time from polymers, paper, or powdered metal. Most machines are fairly autonomous, needing little human intervention. [7]

Clean and Finish: The final step is post-processing. This involves removing the prototype from the machine and detaching any supports. Some photosensitive materials need to be fully cured before use. Prototypes may also require minor cleaning and surface treatment. Sanding, sealing, and/or painting the model will improve its appearance and durability. [7]

Technologies

The different technologies are being used in this technology, some of them are mentioned below:

***Stereo Lithography*:** The technique builds 3D models from liquid photosensitive polymers that solidify when exposed to ultraviolet light. . A low-power highly focused UV laser traces out the first layer, solidifying the model's cross section while leaving excess areas liquid. Next, an elevator incrementally lowers the platform into the liquid polymer. A sweeper re-coats the solidified layer with liquid, and the laser traces the second layer a top the first. This process is repeated until the prototype is complete. [7]

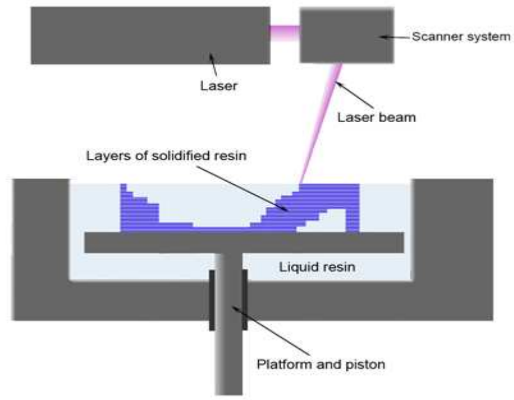
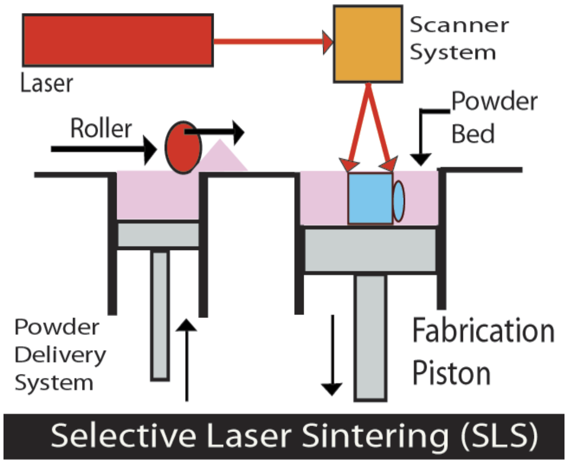


Fig 1: Schematic diagram of Stereo lithography

Laminated Object Manufacturing: A feeder/collector mechanism advances the sheet over the build platform, where a base has been constructed from paper and double-sided foam tape. Next, a heated roller applies pressure to bond the paper to the base. A focused laser cuts the outline of the first layer into the paper and then cross-hatches the excess area (the negative space in the prototype). Cross-hatching breaks up the extra material, making it easier to remove during post-processing. During the build, the excess material provides excellent support for overhangs and thin-walled sections. After the first layer is cut, the platform lowers out of the way and fresh material is advanced. The platform rises too slightly below the previous height, the roller bonds the second layer to the first, and the laser cuts the second layer. This process is repeated as needed to build the part, which will have a wood-like texture. [7]

Selective Laser Sintering: The technique, shown in Fig, uses a laser beam to selectively fuse powdered materials, such as nylon, elastomeric, and metal, into a solid object. Parts are built upon a platform which sits just below the surface in a bin of the heat-fusible powder. A laser traces the pattern of the first layer, sintering it together. The platform is lowered by the height of the next layer and powder is reapplied. This process continues until the part is complete. [7]



.Fig 2: Schematic diagram of Selective Laser Sintering.

Theory

3-D printing raises a number of regulatory challenges including in relation to intellectual property protection. Just as the digitization of creative content has forced change within the creative industries and fuelled tensions around existing copyright law, similar debates are likely to emerge in relation to 3-D printing. Given the global scale of manufacturing, however, the stakes in this debate may be even greater.3-D printing is both a manufacturing and a digital technology and as such it makes the unauthorized copying of objects easier. Like other digital files, CAD blueprints are easy to copy and difficult to track. Copying is also made easier by the availability of low-cost 3-D scanners, which enable anyone to scan an off-the-shelf product, create a 3-D blueprint and distribute it online. [5]

Application

3-D printing was originally developed for rapid prototyping purposes, making one or two physical samples. It allowed designers to identify and correct design flaws quickly and cheaply, thereby speeding up the product development process and minimizing commercial risks. According to business analysts CSC, prototyping remains the largest commercial application of the technology, accounting for some 70 percent of the 3-D print market. However, improvements in the technology's accuracy and speed, as well as in the quality of materials used for printing, have prompted some commercial sectors to move beyond the use of 3-D printing in their research and development (R&D) labs and incorporate it into their manufacturing strategy. [5]

Automotive and aerospace sectors

3-D-printed aircraft components are 65 percent lighter but as strong as traditional machined parts, representing huge savings and reduced carbon emissions. For every 1 kilogram reduction in weight, airlines save around US$35,000 in fuel costs over an aircraft's life. It can be used for a wide variety of materials from metals to plastics - including composites - and is faster and more efficient to produce. It uses fewer raw materials and produces parts which are lighter, more complex and stronger. [5]

Medicine

Medicine is perhaps one of the most exciting areas of application. Beyond the use of 3-D printing in producing prosthetics and hearing aids, it is being deployed to treat challenging medical conditions, and to advance medical research, including in the area of regenerative medicine. The breakthroughs in this area are rapid and awe-inspiring. In February 2012, with the help of a 3-D printer, doctors and engineers at Hasselt University successfully performed the world's first patient-specific prosthetic jaw transplant for an 83-year-old woman suffering from a chronic bone disease.[5]

Rapid manufacturing:

Advances in RP technology have introduced materials that are appropriate for final manufacture, which has in turn introduced the possibility of directly manufacturing finished components. One advantage of 3D printing for rapid manufacturing lies in the relatively inexpensive production of small numbers of parts. [8]

Mass customization:

Companies have created services where consumers can customize objects using simplified web based customization software, and order the resulting items as 3D printed unique objects. This now allows consumers to create custom cases for their mobile phones. Nokia has released the 3D designs for its case so that owners can customize their own case and have it 3D printed. [8]

Conclusion

3D printing technology have reduces the complex process of printing into a single and simple way. Nothing communicates ideas faster than a three-dimensional part or model. With a 3D printer you can bring CAD files and design ideas to life – right from your desktop. Test form, fit and function – and as many design variations as you like – with functional parts. In an age in which the news, books, music, video and even our communities are all the subjects of digital dematerialization, the development and application of 3D printing reminds us that human beings have both a physical and a psychological need to keep at least one foot in the real world. 3D printing has a bright future, not least in rapid prototyping (where its impact is already highly significant), but also in medicine the arts, and outer space. Desktop 3D printers for the home are

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already a reality if you are prepared to pay for one and/or build one yourself. 3D printers capable of outputting in colour and multiple materials also exist and will continue to improve to a point where functional products will be able to be output. As devices that will provide a solid bridge between cyberspace and the physical world, and as an important manifestation of the Second Digital Revolution, 3D printing is therefore likely to play some part in all of our futures.

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References

[1] http://www.instructables.com/id/3D-Printing

[2] http://individual.troweprice.com/staticFiles/Retail/Shared/PDFs/3D_Printing_Infographic_FINAL.pdf

[3] http://www.industryweek.com/emerging-technologies/history-3-d-printing-slideshow

[4] http://www.3ders.org/3d-printing-basics.html

[5] http://www.wipo.int/wipo_magazine/en/2013/02/article_0004.html

[6] http://www.imaginarium.co.in/tech-3d.html

[7] *http://www.arctron.de/uploads/media/3DPrinting-Info.pdf*

[8] http://iysn.org/2011/09/17/pushing-boundaries-3-d-printing/

[9] www.journalistsresource.org/wp-content/uploads/2013/03/3d-printing.pdf