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TITLE: 3D-PRINTING

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Abstract

3D printers are a new era of machines that can make every day things. They're magnificent because they can produce different types of objects, in exceptional materials, all from the same machine. A 3D printer can make relatively an awful lot whatever from ceramic cups to plastic toys, metallic machine parts, stoneware vases, fancy chocolate cakes, etc. They exchange standard manufacturing facility manufacturing lines with a single computer simply like domestic inkjet printers replaced bottles of ink, a printing press, warm steel kind and a drying rack. 3D printing is a kind of additive manufacturing technological know-how where a three dimensional object is made with the aid of laying down successive layerof fabric which forms the closing object.The greater superior 3Dprinting technologies presently yield models that intent ly emulate the appearance and performance of the closing product. 3D printing is accomplished the use of an additive process. A materials printer normally performs 3D printing tactics using digital technology. The first working 3D printer was created in 1984 by Chuck Hull. Since the begin of the 21st century there has been a large booming the sales of these machines, and their price has dropped appreciably .The 3D printing technology is used for each prototyping and distributed manufacturing with functions in architecture, construction, industrial design, automotive, aerospace, military, engineering, Dental and clinical industries, biotech (human tissue replacement), fashion, footwear, jewellery ,eyewear, education, geographic data systems, food, and many other fields. It has been speculated that 3D printing might also grow to be a mass market item because open source 3D printing can without difficulty offset their capital expenses with the aid of enabling buyers to avoid fees associated with buying common.

Index Terms: three dimensional object, additive manufacturing process, successive layers, traditional factory

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1. INTRODUCTION

3D Printing is a procedure for making a bodily object from a three-dimensional digital model, typically by means of laying down many successive thin layers of a material. It brings a digital object (its CAD representation) into its bodily form by adding layer by way of layer of materials. 3D Printing brings two indispensable innovations: the manipulation of objects in their digital layout and the manufacturing of new shapes via addition of material. Digital + Additive Manufacturing Technology has affected recent human history in all likelihood more than any different field. Think of a light bulb, steam engine or, more latterly, automobiles and airplanes, not to point out the rise and upward jab of the World Wide Web. These technologies have made our lives better in many ways, opened up new avenues and possibilities, but typically it takes time, from time to time even decades, earlier than the simply disruptive nature of the science turns into apparent. It is widely believed that 3D printing or additive manufacturing (AM) has the full-size potential to become one of these technologies. 3D printing has now been included across many television channels, in mainstream newspapers and across on-line resources. The most basic, differentiating principle behind 3D printing is that it is an additive manufacturing process. And this is certainly the key because 3D printing is a radically special manufacturing approach based on superiortec hnological know-how that builds up parts, additively, in layers at the sub mm scale. This is basically exceptional from any other present normal manufacturing techniques. However, these applied sciences all demand subtracting material from a large block whether to reap the cease product itself or to produce a device for casting or molding approaches and this is a serious hindrance within the basic manufacturing process. 3D printing is a method for developing objects directly, by including cloth layer through layer in a range of

ways, depending on the science used. Simplifying the ideology behind 3D printing, for all people that is nonetheless making an attempt to apprehend the concept (and there are many), it could be likened to the process of building something with Lego blocks automatically.

2. HISTORY

In 1984, Chuck Hull of 3D Systems Corporation filed his own patent for a stereo lithography fabrication system, in which are added by curing photopolymers with ultraviolet light lasers. Hull defined the process as a "system for generating three-dimensional objects by creating a cross-sectional pattern of the object to be formed," Hull's contribution was the STL (Stereo lithography) file format and the digital slicing and infill strategies common to many processes today.

1995: In 1995 the Fraunhofer Institute developed the selective laser melting process.

2009: Fused Deposition Modeling (FDM) printing process patents expired in 2009.

As the various additive processes matured, it became clear that soon metal removal would no longer be the only metal working process done through a tool or head moving through a 3D work envelope transforming a mass of raw material into a desired shape layer by layer. The **2010s** were the first decade in which metal end use parts such as engine brackets and large nuts would be grown (either before or instead of machining) in job production rather than obligatory being machined from bar stock or plate. It is still the case that casting, fabrication, stamping, and machining are more prevalent than additive manufacturing in metalworking, but AM is now beginning to make significant inroads, and with the advantages of design for additive manufacturing, it is clear to engineers that much more is to come.

As technology matured, several authors had begun to speculate that 3D printing could aid in sustainable development in the developing world.

2012: Filabot develops a system for closing the loop with plastic and allows for any FDM or FFF 3D printer to be able to print with a wider range of plastics.

2013: NASA employees Samantha Snabes and Matthew Fiedler create first prototype of large-format, affordable 3D printer, Gigabot, and launch 3D printing company 3D.

2018: 3D develops a system that uses plastic pellets that can be made by grinding up waste plastic.

3. WORKING

There are 3 most important steps in 3D printing.

The first step is the education simply before printing, when you format a 3D file of the object you desire to print. This 3D file can be created using CAD software, with a 3D scanner or certainly downloaded from an on line marketplace. Once you have checked that your 3D file is geared up to be printed, you can proceed to the second step.

The second step is the proper printing process. First, you want to selectwhich cloth will pleasant gain the specific pr operties required for your object. The variety of substances used in 3D printing is very broad. It includes plastics, ceramics, resins, metals, sand, textiles, biomaterials, glass, food and even lunar dust! Most of these materials additionally enable for masses of ending picks that enable you to acquire the particular designed result you had in mind, and some others, like glass for example, are still being developed as 3D printing material and are now not effortlessly available yet

The third step is the ending process. This step requires precise capabilities and materials. When the object is first printed, often it cannot be at once used or delivered till it has been sanded, lacquered or painted to complete it as intended.
The material chosen for the challenge will determine which printing techniques are most suitable. Among these, the most oftentimes used techniques for each team of substances a re described next.
If you choose to use Plastic or Alumide

Fused Deposition Modeling (FDM) Technology: is at the very entry of the market as it commonly used by using individuals. It is in all likelihood the most famous printing method due to the quantity of printers handy on the market. FDM is an low-priced 3D printing system in contrast to different 3D printing technologies. This system works by using material being melted and extruded thru a nozzle to 3D print a go part of an object every layer at a time. The mattress lowers for every new layer and this method repeats till the object is completed. Layer thickness determines the fine of the 3D print. Some FDM 3D printers have two or extra print heads to print in multiple colours and use support for overhanging areas of a complicated 3D print.

SLS Technology: Laser sintering is a 3D printing technique consisting of the fabrication of an object via melting successive layers of powder collectively in order to shape an object.
The technique most notably enables in
the creation of complex and interlocking forms. It is handy for Plastic and Alumide .If you choose to evaluate these two technologies in order to discover the pleasant proper for you, have a seem to be to our showdown FDM vs. SLS. If you desire to use Resin two or the technological know-how you will need is the photopolymerisation, a approach that involves the solidification of photo-sensitive resin by means of ability of a UV light. It is used through exceptional 3D printing methods such as:

Stereolithography (SLA): makes use of a tank of treatable photopolymer sap. The assemble plate slides in little additions and the fluid polymer is introduced to light the place the UV laser attracts a move section layer through layer.
The method is rehashed until a model has been made. The article is 3D printed by way of hauling the item out of the gum (base up), which makes area for the uncured tar at the base of the holder and would then be capable to form the following layer of the item. Another approachis to 3D print the item by maneuvering it descending into the tank with the following layer being relieved on the best.

Digital Light Processing (DLP) a projector is utilized to fix photopolymer tar. This is basically the identical as the SLA approach with the exception of that as adversarial to making use of an UV laser to restoration the photopolymer pitch, a safelight (light) is utilized. Articles are made correspondingly to SLA with the object being either hauled out of the gum, which makes house for the uncured tar at the base of the holder because of this shaping the following layer of the article, or down into the tank with the following layer being relieved at the best.

Sculpteo utilizes DLP innovation for Silver and Brass 3D printing. We 3D print a wax show first at that point, we make use of a lost-wax throwing strategy: a shape is made round the wax earlier than it is liquefied and loaded up with silver, making your article.

Continuous Liquid Interface Production (CLIP) works by way of awaiting a constant succession of UV pictures, created by using a computerized light projector, via an oxygen-penetrable, UV-straightforward window below a fluid pitch shower. The no man's land made over the window keeps up a fluid interface underneath the part. Over the no man's land, the restoring section is drawn out of the tar shower.

MultiJet printers: Similar to Stereolithography, the exceptional PolyJet and MultiJet 3D printing methods use a UV mild to crosslink a photopolymer. However, alternatively than scanning a laser to **cure** layers, a printer jet sprays tiny droplets of the photopolymer (similar to ink in an inkjet printer) in the shape of the first layer. The UV lamp connected to the printer head crosslinks the polymer and locks the shape of the layer in place. The build platform then descends through one layer thickness, and more fabric is deposited directly ontothe preceding layer.

If you want to use Metal

- DLP combined with the lost-wax casting technique allows objects to be printed in 3D. Sculpteo uses DLP technology for Silver and Brass 3D prints. First, we 3D print a wax model. Then, we use a lost-wax casting technique: a mould is made around the wax before it is melted and filled with silver, thus creating your object.

- Direct Metal Laser Sintering (DMLS) uses a laser as a power source in order to sinter metal powder by aiming a laser and tracing a cross section of the object layer by layer. Direct Metal Laser SIntering is similar to the selective laser sintering process.

- Electron Beam Melting (EBM) uses an electron beam as the power source instead of a laser to 3D print metal. An electron beam melts metal powder layer by layer within a high vacuum and can achieve full melting of the metal powder. This method can produce high-density metal parts thus retaining the material's properties.

If you want to use Multicolor

Fig: Models printed by 3D printer.

- **Binder Jetting** is popular since you can create detailed 3D prints with color. An automated roller is used to spread a layer of powder onto the build platform. Excess powder is pushed to the sides and ensures that the bed is filled with a layer of packed powder. On a fast axis, the print heads apply a liquid binder and colour simultaneously to create a cross section of the object on the powder.

- **Selective Deposition Lamination** is a 3D printing process using paper. This process is similar to Laminated Object Manufacturing (LOM) rapid prototyping method. The process involves layers of adhesive coated paper (or plastic or metal laminates) that are successively glued together with a heated roller and cut to shape with a laser cutter layer by layer. A roller with the material moves each

new sheet of material over the last and repeats the process until the object is completed.

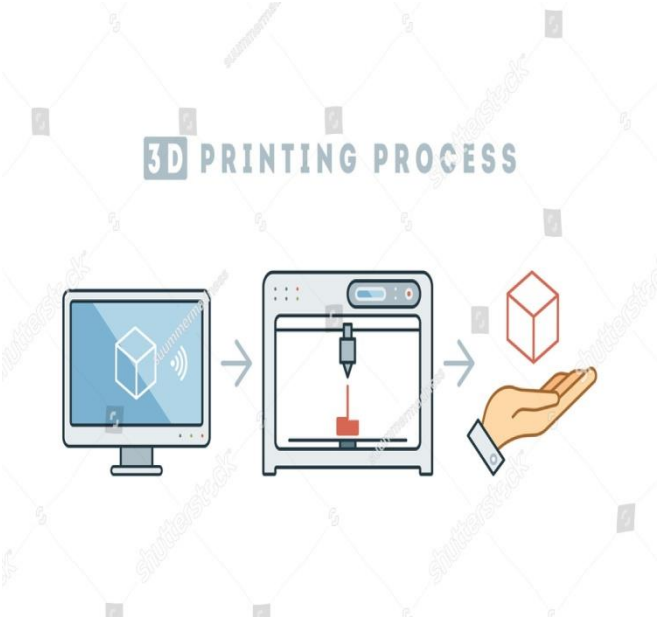
- **Triple-jetting technology (PolyJet)** used in Stratasys Objet500 Connex3, is the most advanced method of PolyJet 3D printing. This technology performs precise printing with three materials and thus makes three-colour mixing possible. To know more about this technology, you can refer to PolyJet & Multijet

4. ADVANTAGES

- **Reduce cost:**Less machine,material and labour cost
- **Machine cost** : machine operation cost play a very small part in overall cost in manufacturing process , the ability to develop and complex parts and product in one step creates an increased level of efficiency and saves on time
- **Labour cost**:3d printing is a fact that labour cost are kept low unlike a traditional manufacturing each 3d printer will require an operator to start a machine before it begins an automated process of creating the uploaded design.
- **Material cost**: As this relatively new technology that is gaining momentum the material cost can still remain high and as the range of material is growing and this makes it possible for the price to decrease overtime
- **Less travel cost**: As 3d printers can create a product from start to finish it unables designers to design a product in one country , email it to another country in preparation for production thus it reduces in shipping , air travel and road travel .
- **Reduce time:** We live in a fast paced world where everything is required quickly and so, this is where 3D printing can really make a difference. One of the big advantages of 3D printing is that parts and products can be manufactured a lot quicker than they can using traditional methods. Complex designs can be created as a CAD model and then transformed into a reality in just a few hours. This delivers design ideas in a way that enables them to be verified quickly and designed in a short space of time.

5. DISADVANTAGES

- **High energy consumptions**: 3D printers consume approximately 50 to 100 times more energy than injection moulding.
- **3D printer technology is expensive**: 3D Printing Technology is Expensive 3D printing equipment and materials cost make the technology expensive. Industrial grade 3D printers are still expensive costing hundreds of thousands of dollar, which makes the initial expenses of using the technology very high
- **Harmful Emissions**: 3D printers used in enclosed places such as homes can generate potentially toxic emissions and carcinogenic particles according to researchers at the Illinois Institute of Technology. Their 2013 research study showed that 3D desktop computers could emit large numbers of ultrafine particles and some hazardous volatile organic compounds during printing table



6. FLOWCHART

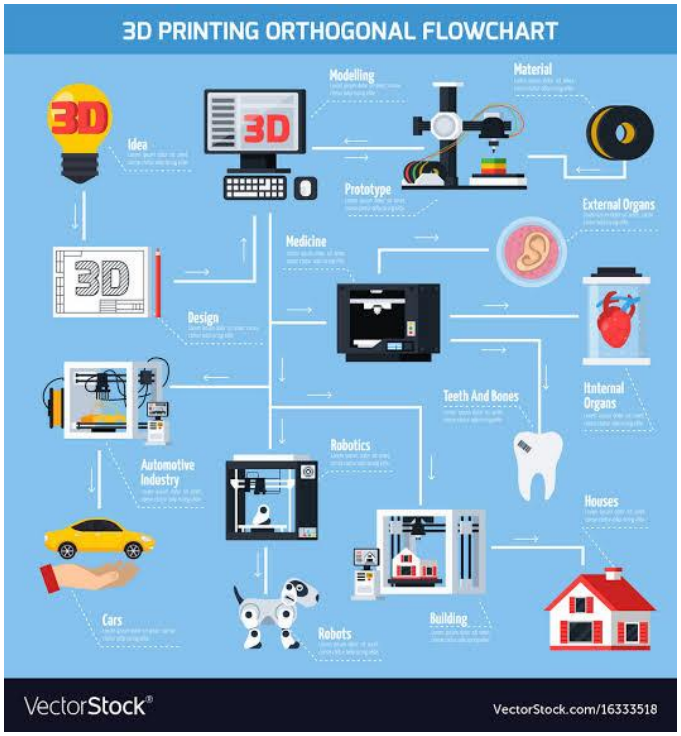


Fig-1: 3D printing orthogonal flow chart

7. CONCLUSION

It is generally accepted that 3D printing will be a revolutionary force in manufacturing, whether positive or negative. 3D printer is very efficient as it reduces labour work due to automated process and also saves the time and money. .

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