# 3D Printers from Dimension to Technology

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***Abstract*- 3D printing also known as Additive manufacturing technology and it is a process of making three dimensional solid objects adding material layer by layer. Physical objects are produced by using digital model data from 3D model or other data source, like AMF* file.**

**By using 3D Printing it is possible to produce objects of almost any shape and form. Currently many different 3D printing technologies and materials are used.**

**Recently 3D printing tools are available for industrial manufacturing and for home users as well.**

## 1. INTRODUCTION

3D printing or additive manufacturing, it is known as additive manufacturing because we do manufacture by printing through adding different materials. It's a three dimensional solid objects which you virtually make from a digital model. Each successive layer of the additive material are laid down in distinct shape. If we consider the traditional way of manufacturing of any object is quite complicated and completely rely on machine techniques like drilling, milling, cutting, etc. whereas in case 3-D printing we just need to add a successive layer of respected digital image. Thus 3D printing uses the layering technology that is too easier than machining techniques.

In layering technology, object is build layer by layer until the complete product is manufactured. Because of this we can also exempt the production line to a one-off customizable production. You can make anything, whatever you can design you can make through 3D printing. Recently there are many houses are completely made by 3D printing not just house several parts of electronic industry to the big parts of human body everything can be manufactured by 3D printing.

First time David E. H. Jones introduced the concept of 3D printing in his column of Ariadne in the journal New Scientist in 1974. After 1974, 3D printing idea has been circulated all over the world and in 1980 the additive manufacturing materials and equipment started manufacture.

Officially the first 3D printer is invented by Chuk Hull in 1984. He filled his own patent of STL stands for stereo lithography fabrication system in which curing process take place to make a new successive layer.

Now 3d printers are widely used in home as well as commercial purpose.

From 1984 the design and technology of 3D printer has been changed widely. Now a days 3D printer has also enormous usage in medicine field like surgical tools, patient-specific surgical models and custom-made prosthetics. Certainly 3D printer is creating a positive change in every sector of medicine.

## 2. WORKING FUNCTION OF 3D PRINTING

Imagine you have to make an ordinary prototype of a car. You would start with a block of solid wood and start shaping it in required shape without having a knowledge of interior because it is going to be hidden and what about when you start working on real state-building so as a prototype you would make walls made of card-boards and after all the cut-off materials will be done you can stick it together but 3D printers don't work in either way.

If we look out the above two examples then we can easily notice in both cases we need to give extra efforts, accuracy and precession and in most of the time your designed imagination and the object, in reality, has a far big difference.

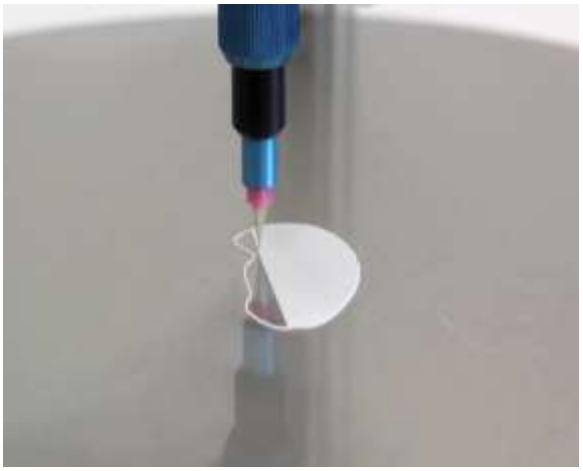
In the case of 3D modelling, you make what you have designed it is as easy as to print with an inkjet printer.

It starts with the design of the product, designing is the most crucial part of 3D printing whatever you design you will get the same print/3D model, so all the efforts depend on your design or your creativity.

It starts by making a virtual design of respective object on designing software like AutoCAD, Maya, etc.

The Virtual design will be as a template of an object.

There is an easy way to design any 3D object, you can simply say replica of any object you want to make, you just need an 3D scanner which scans complete dimensions of object and your CAD software will automatically convert it into a 3D design but in the end it depends on you in what material you want print. After designing of material CAD (computer aided design) automatically converts it into thousands of or millions of (depends on the size of object) horizontal layer in order to print for 3D printing. Furthermore this 3D design file is uploaded on 3D printer and it will start making the object layer by layer as shown in figure below[1]



The image is shown the working of 3D printer layer by layer bye reading the 2D image of CAD software.

## 3. INDUSTRIAL APPLICATIONS

3D printing can be used in variety of fields I am taking some examples of them below.

a) Apparels: Company named as CONTINUUM is the first company in the world who has created wearable.

3D printed dress. This company is based on San Francisco and on their websites customers design bikinis. For this fabrication printing company has used nylon to print [2]. In fashion industries it is becoming a trend to show these unique dresses. This company also makes foot wears through 3D printing [3].

b) Constructions: There are several houses has been made through 3D printing in all over the world. 3D printing can play a important role in the field of construction. In Switzerland, there is complete infrastructure made by 3D printing in 2019 and it is now open to all. [4]

The above image shows the printing of wall through 3D printer and its easy to make at less cost. 3D printing can save a lot in infrastructure, it saves approx 30% to 60% waste and decrease production time by 50 – 70 percent and also it affects labour cost in between 50 – 80 percent of savings.[5]

The advantages of 3D printing in construction is that it is environment friendly, inexpensive, shorter construction period and complicated shapes are also can be made through 3D printing.

Some disadvantages are also of 3D printing in making infrastructure like it needs hug printers and one printer can't make multiple materials so variety of 3D has to be there and the major disadvantage is unemployment will increase because of automation of this sector.

c) Space: The Zero-G Printer is the first 3D printer designed to operate in zero gravity. Which was launched into space in September 2014, the

printer was built under a joint partnership between NASA Marshall Space Flight Center (MSFC) and Made In Space.[6]

d) Medical Devices: In 2014, a five year old girl born with abnormal finger on her left hand in UK. The US-based company named e-NABLE,an open source design organization made an prosthetic hand with the help of 3D printing technology.[7]

## 4. ADDITIVE MATERIALS FOR 3D PRINTING

When we talk about 3D printing then even the sky is not going to be limit. There are many materials have made or found which is suitable for 3D printing even researchers are still working on some materials in order to use it for 3D printing. Most common material is PLASTICS which can be used with different engineering grades like PEEK or very easy to use like PLA.

When the first 3D Printer was made in 1984, Resin was used to print and this material is basically used with SLA printers. There are some composite materials we are using in 3D materials, as the word say composite, it's the mixture of different material to get the better quality products.

Below we will discuss some different type of materials which are suitable for 3D printers

1 ABS: Most affordable material for 3D printing, its quite strong, high resolution, flexible and light weighted. This material is used in 3D printer at high temperature in between 220 – 250 degree Celsius.

2 PLA: It is also a public demanded product for 3D printing. The specialty of PLA is, it is biodegradable(Environment friendly). It is made from corn, cassava, sugarcane or sugar beet pulp.

3 NYLON: It is the choice for premium products from a wide range of applications. Properties like flexibility and strength of nylon make it more valuable

4 PVA: Engineered to be soluble and extensively used for support material because other support materials requires special chemicals to dissolve.

5 ALUMIDE: In terms of physical properties it is comparatively similar to nylon. It's a composite material of nylon with aluminum. The difference one can find in shiny and porous surface finish. Alumide is also more durable

6 Aluminum: Used in the wide range of applications because of its strength, lightweight, heat resistant, corrosion-resistant, and versatility It is used in different aluminum-based premium alloys. Highly recommended for products with high mechanical stress.

7 COBALT CHROMIUM: Well known as superalloy because of high strength, biocompatible, heat resistant, corrosion resistant, hard wearing and low conductivity. Most preferably used in high performance application

8 TITANIUM: Expensive and the most versatile material to be used for 3D printing. Used in the form of pure powder for metal 3D printing. 3D printing of titanium mostly used in automotive, aerospace and tooling industries.

9 WAX: Not used for the final product but uniformly used to make prototypes. Have high resolution and smooth surface easy to make.

## 5. BENEFITS

There are many advantages of 3D printing apart from easily manufactured or low production cost.

1 LOWER COST: In China, one company was able to construct 10 one storey buildings at less than $5000 per house [9]. Construction of a similar house costs mostly more than the double of this cost.

2 TIME: Printing of the 3D object can be done directly, differing from the long-established manufacturing where you had to join different components to form the final product. Three-dimensional printing allows businesses to construct working models in just hours instead of days or weeks [8] [10].

3 FASTER PRODUCTION - While slow at times, 3D printing can be faster than some conventional and complicated processes like injection molding and subtractive production.

4 EASILY ACCESSIBLE - 3D printing has been around for a few decades now and has implemented vastly since around 2010. There are now a wide variety of printers and software packages available (many of them are open-source) making it easy for almost everyone to learn how to do it.

5 BETTER QUALITY PRODUCTS - 3D printing produces a consistent quality of product. So long

as the model is accurate and fit for purpose, and the same type of printer is used, the final product will usually always be of the similar quality.

6 GREAT FOR DESIGN AND PRODUCT TESTING - 3D printing is one of the best tools for product design and testing. It provides opportunities to design and test models to allow clarification with ease.

7 PRODUCT DESIGNS ARE ALMOST INFINITE - The possibilities of 3D printing are almost limitless. So long as it can be designed in CAD and the printer is big enough to print it, the sky is the limit.

8 3D PRINTERS CAN PRINT USING VARIOUS MATERIALS - Some 3D printers can actually blend or switch between materials.

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