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## **3D Printing and Its Applications**

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### **Abstract**

3D printing is a form of additive manufacturing which outputs a 3D model of a object through a layer by layer process by taking in input a CAD (computer aided design) file. This technique is fast and saves time involved in basic manufacturing process. In this one has to just design the 3D image of object using CAD, then after selecting the material to be used this information is sent to printer which then prints the object. Depending on the materials used and the procedure employed in forming the object there are various methods of 3D printing such as stereo lithography, fused deposition modeling, selective laser sintering. 3D printing finds its applications in every domain from medical, defense, factories, fashion, retail, food, architecture, functional prototyping, concept modeling, end user parts and many more which will be focused in this paper. Moreover its future applications are vast that includes using 3D printing for on demand parts in space, for printing organs and for making complex engine parts.

**Keywords:** 3D printing, 3D printers, Stereo lithography, Additive manufacturing, Fused deposition modelling (FDM), Selective laser sintering (SLS), Bio-printing.

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### **I. Introduction**

3D printing which is also known as additive manufacturing refers to various processes which is used to produce a 3D object using a CAD (computer aided design) software. Early additive manufacturing materials were developed in 1980s [1].

Later on there were many advancement in the following years in this field.

3D printing involves a 3D printer which prints the object layer by layer by extruding the required material. Main principle involved is stereo lithography in which a 3D image of the object which is to be produced is made using triangles and stored in a STL file format. This can be done by using computer aided software or by a 3D scanner. Using a computer we can vary different dimensions of object easily with reduced errors and easy verification of design.

After designing next comes the printing part in which the printer reads the STL file of object and lays down different layers of materials to form the final object.

Finishing constitute the final part of 3D printing in which finishing of the printed object is done. This may include removing the unnecessary part or hardening the required part with laser.

There are many processes that can be used to produce a 3D printed object like stereo lithography, fused deposition modeling (FDM), selective laser sintering (SLS), polymerization which vary upon the procedure used during printing.

3D printing has a wide range of applications in every domain mainly medical, industrial, space. Studies are going in field of medical to print body parts and soon in future it may turn into reality. We can also 3D print food and NASA is also planning to 3D print food, parts of machine as and when needed by astronomers there in space and also working to 3D print a lunar base on moon.

In future everything will be 3D printed instantly when required thus surely 3D printing signals the beginning of a third industrial revolution as suggested by futurologists Jeremy Rifkin [2].

### **II. Methods Of 3d Printing**

Most widely used methods are SLS, FDM, and stereo lithography. All of these are additive manufacturing process.

Selective laser sintering (SLS) uses two piston namely powder delivery and fabrication piston. A roller rolls the powdered material on to the fabrication system. In this a high power laser like CO2laser is used to harden the desired 3D shape of object and it does so through fusing small particles of plastic, metal , ceramic into a mass. This can be used for architectural uses.

In Fused deposition modelling (FDM) a build material spool which ends up extruding material filament is used. This forms the object by extruding and heating of thermoplastic filament. The great advantage of this technique is durability, stability and quality of parts formed. It is used for prototyping modelling and production applications where high accuracy of functional parts is needed.

In Stereo lithography object is formed on to the vat of liquid polymer that gets hardens when laser focuses on the required cross section. It is preferred for rapid prototyping.

### **III. Applications**

3D printing applications are diverse just as the materials that can be used to print a 3D object. Approximately more than hundred materials are been recognized that includes plastic, metal, living tissue, concrete, polymers, food ingredients that can be 3D printed.

Considering applications of 3D printing in medical it can be used for mass customization and production of medical equipment. Using this method the cost and time taken in producing final object decreases significantly.

It can be used for making of bones that can serve as artificial organs for disabled. 3D printing is used by doctors to understand the real complexity involved in operations like in heart valve transplant, kidney transplant, cranium replacement, hip surgery etc. by making a models before the actual operations.

Synthetic skin produced using 3D printers can now save the lives of burn victims and others. Researches in using a 3D printed kidney transplant are going and once it become

successful the problem of organ transplant will go insane as any organ can then be 3D printed on demand.

In drugs and medicine manufacturing too 3D printing plays a great role.

Other applications come in manufacturing on-demand tools in a quick and customized manner. It can be used to print end user parts like bolts, nuts, and machinery parts in a cheaper rate than traditional manufacturing process.

Now a day's 3D printed is at its highest peak in fashion industry and there are many 3D printed dresses, jewellery, footwear, accessories available. 3D printer can be used to sustainably 3D print food items like cakes, chocolates.

3D printing also helps engineers in conceptual modelling and functional prototyping for creating a realistic prototype of final object.

Architectural firms use 3D printing to create a prototype model to help client to visualize design better and also to actually 3D print buildings these days.

#### **IV. Future Scope**

In future 3D printing can be used by astronomers to make engine parts, food there in space whenever they needed. This will reduce the amount of things carried to space station. Its usage has been started and the Mars Rover comprises some 70 3D printed parts.

NASA after discovery of water beneath surface of Mars is now planning to 3D print biodegradable fungus towers that would leave no trace on Mars [3]. It can be used to create 3D printed lunar base automatically using 3D printer just as a robot.

3D printers can be used for making future buildings in less cost and time.

3D printing in medical industry or Bio printing is the most exciting areas of future applications in which it can be used to create organs of human body. If this happens the problem of organ donor will be solved.

It will take manufacturing industries to new heights and in future it will be used to create complex engine parts and every item will match the exact user specifications.

We can also 3D print our clothes at home in future. So it is not wrong to say next generation would be of 3D printing in which one would print any item as and when needed.

#### **V. Conclusion**

3D printing, a additive manufacturing process is more accessible and useful these days. It prints the item in less time, cost with high accuracy, flexibility and durability of processes. It finds it applications in every field and by increasing the amount of input given to 3D printer these applications can be increased.

With future applications in Bio-printing it would remove the problem of organ donor finding as organs can be printed when needed. In space also its applications found a deep root which can be used by the astronomers to make things in space.

After understanding the various methods and applications of 3D printing, we can conclude that it would change the quality of life we lived and would bring upcoming industrial revolution.

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