Selection of 3D Printing Method

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Abstract- *This is a research paper on 3D printing which has become a notable topic in today's technological discussion. In this paper, we will look at additive manufacturing or 3D printing. Different 3D printers make use of different kind of technologies, printing methods and also different kinds of materials. We shall also see the advantages of 3D printing as compared to conventional methods of manufacturing. We shall observe the numerous applications it is being out to use today. This paper gives a general introduction to the concept of 3D printing, the different types of printing technologies with their advantages, limitation and compares each of them to different criteria such as surface finish, dimensional accuracy, material used, post processing requirements etc.*

I. INTRODUCTION

Traditional machining such as turning, milling, drilling and grilling has been around for many years and has helped human beings to build things. Although the technology for traditional machining has evolved in recent years, it has a number of limitations. With the introduction of non-traditional machining such as electric discharge machining or electric chemical machining, the manufacturing world has changed and at present nearly all industrial processes require computers and robot technology. These processes stated all involve removing material from a larger mass of block to get the required shape of the final product. There are constraints such as fixtures and assembly for many traditional designs and their production processes which are often expensive and add cost to the production process.

Additive manufacturing (AM) is a term to describe set of technologies that create 3D objects by adding layer-upon-layer of material. Materials can vary from technology to technology. But there are some common features for all Addictive Manufacturing, such as usage of computer together with special 3D modelling software.

The term Additive Manufacturing holds within such technologies like Rapid Prototyping (RP), Direct Digital Manufacturing (DDM), Layered Manufacturing and 3D Printing. There are different 3d printing methods that were developed to build 3D structures and objects. Some of them are very popular nowadays; others have been dominated by competitors.

A. 3D PRINTING METHODS:

1. Stereo Lithography (SLA): Stereo lithography (SLA) is a form of 3-D printing technology used for creating models, prototypes, patterns, and production parts in a layer by layer fashion using photo-polymerization, a process by which light causes chains of molecules to link, forming polymer. Stereo lithography is used to create prototypes for products and in medical modelling, among other uses. Stereo lithography is fast and can produce almost any design, it can be expensive.

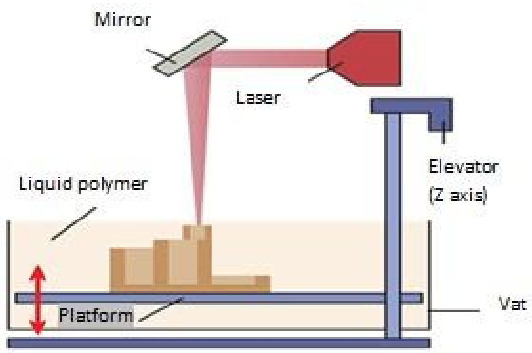

Fig1: Stereo lithography

2. Fused Deposition Modelling (FDM): 3D printing machines that use FDM Technology build objects layer by layer from the very bottom up by heating and extruding thermoplastic filament. The whole process is a bit similar to stereo lithography. Firstly, special software "cuts" CAD model into layers and calculates the way printer's extruder would build each layer. Along to thermoplastic a printer can extrude support materials as well. Then the printer heats thermoplastic till its melting point and extrudes it throughout nozzle onto base, which can also be called a build platform or a table, along the calculated path. A computer of the 3d printer translates the dimensions of an object into X, Y and Z coordinates and controls that the nozzle and the base follow calculated path during printing. To support upper layer the printer may place underneath special material that can be dissolved after printing is completed.

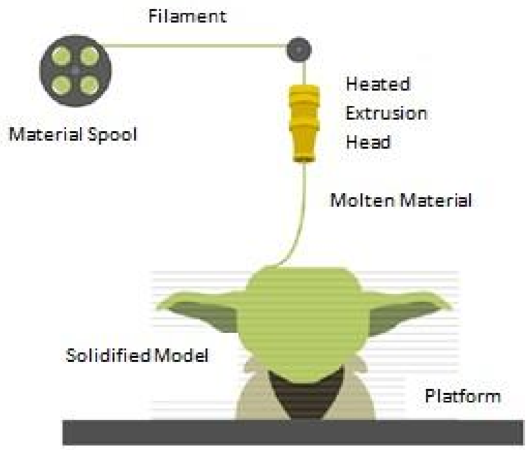

Fig2: Fused deposition modelling

3. Selective Laser Sintering (SLS): Selective Laser Sintering (SLS) is a technique that uses laser as power source to form solid 3D objects. The main difference between SLS and SLA is that it uses powdered material in the vat instead of liquid resin as Stereo lithography does. The material to print with might be anything from nylon, ceramics and glass to some metals like aluminium, steel or silver. Due to wide variety of materials that can be used with this type of 3d printer the technology is very popular for 3D printing customized products.

*4. Selective laser melting (SLM):*Selective laser melting (SLM) is a technique that also uses 3D CAD data as a source and forms 3D object by means of a high-power laser beam that fuses and melts metallic powders together. In many sources SLM is considered to be a subcategory of selective laser sintering (SLS). But this is not as true as SLM process fully melts the metal material into solid 3D-dimentional part unlike selective laser sintering.

5. Electronic Beam Melting (EBM): EBM is another type of additive manufacturing for metal parts. The same as SLM, this 3d printing method is a powder bed fusion technique. While SLM uses high-power laser beam as its power source, EBM uses an electron beam instead, which is the main difference between these two methods. The rest of the processes are pretty similar. The material used in EBM is metal powder that melts and forms a 3D part layer by layer by means of a computer, which controls electron beam in high vacuum. Contrary to SLS, EBM goes for full melting of the metal powder. The process is usually conducted under high temperature up to 1000 °C. Comparing to SLM the process of EBM is rather slow and expensive; also the availability of materials is limited. So the method is not so popular though still used in some of manufacturing processes.

6. Laminated Object Manufacturing (LOM):

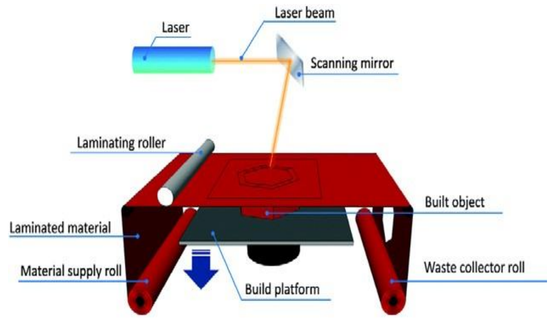

Fig: LOM

During the LOM process, layers of adhesive-coated paper, plastic or metal laminates are fused together using heat and pressure and then cut to shape with a computer controlled laser or knife. Post-processing of 3D printed parts includes such steps as machining and drilling. The LOM process includes several steps. Firstly, CAD file is transformed to computer format, which are usually STL or 3DS. LOM printers use continuous sheet coated with an adhesive, which is laid down across substrate with a heated roller. The heated roller that is passed over the material sheet on substrate melts its adhesive. Then laser or knife traces desired dimensions of the part. Also the laser crosses hatches of any excess material in order to help to remove it easily after the printing is done.

II. APPLICATIONS OF 3D PRINTING

In this technology, conveniently prepared multicellular aggregates (the bio-ink particles) are delivered into a biocompatible support structure according to a design template (compatible with the shape of the desired biological construct) by a computer-controlled delivery device (the bio-printer).More research is still needed to make it happen but the company evidently has the brains and research to figure it out**.**

III. DISCUSSION AND CONCLUSION

3D printing has revolutionized the way in which manufacturing is done. It improves the design manufacturing and reduces lead time and tooling cost for new products. As mention in the section above, there are several technologies used by 3D printers to build objects. The type of technology to be used depends mostly on the object to be manufactured. A comparison was carried out to show which method is the best fit for a particular job.

Even though these technologies are different in their own ways, they bring a host of benefits that conventional manufacturing simply cannot. They can allow customization of products according to the individual needs. They can also build complex products which cannot be produced physically in any other ways.

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