The Importance Role of 3D Printing in India Innovation

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Abstract

3D Printing is one of the most important technological advancement in additive manufacturing which has been implemented and recognized as a part of modern industry as it has many advantages over conventional approach of which one of the most important factor which is time. Generally in fused deposition modeling the component is manufactured using the concept of rapid prototyping and layer by deposition of the material which is done sending the data in to the software of the machine using a stereo lithography (STL) file format made by using modeling software (CAD). In today's world of mechanical engineering the applications of 3D printing are very useful for research and development of various components ranging from simple structures used in everyday life to complicated components in aerospace applications. 3D printing provides many advantages few are simplicity, reliability and precision etc. This makes it one of the most widely used for making components which can be used as concept components. 3D printing is the most widely used additive manufacturing processes is the current industry not only limited to engineering.

Keywords: Stereo lithography, Prototyping, Electronic beam, Thermoplastic, Koenigsegg

I. INTRODUCTION

3D printing refers to processes in which material is joined or solidified under computer control to create a three dimensional object, with material being added to gather 3D printing are used in both rapid prototyping and objective manufacturing (AM). Objects can be of almost any shabe or geometry and typically are produced using digital model data from a 3D model or another electronic data source such as or additive manufacturing file (AMF) file usually in sequential layers. There are many different technologies, stereo lithography (STL) of fused deposit modeling (FDM). Thus, unlike material removed from a stock in the conventional machining process, 3D printing or AM build a 3D object. From computer -added design (CAD) model or AMF file, usually by successively adding material layer by layer.

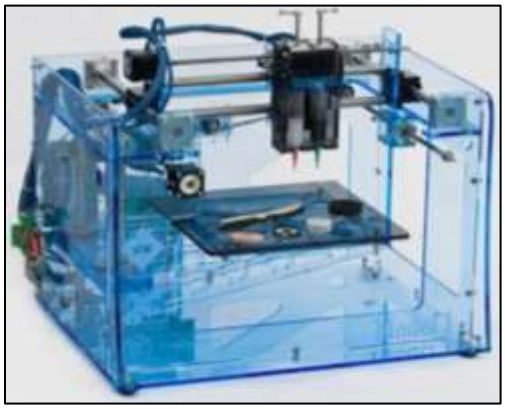

Fig. 1: 3D Printer

The term "3D printing" originally referred to a process that deposited a binder material in to a powder bed with inject printer heads layer by layer. More recently, the term is being used in popular veriacular to encompass a wider variety of additive manufacturing techniques. United States and global technical standards use the official term' Additive Manufacturing' for his broader sense, since the final goal of additive manufacturing is to achieve mass production which greatly differs from 3D printing for rapid prototyping.

II. PRINCIPLE OF 3D PRINTING

A. Working Process of 3D Printing

The main principle of 3D printing is stereo lithography, Which was outlined by Charles Hull in 1987 as a system for generation of three dimensional objects by making cross sectional pattern of the object to be formed.3D drawing software is used to generate 3D objects which is first split into layers and then layers are successfully printed by the machine. The very first step followed in 3D printed is the generation of 3D printable mode. The models are produced by using computer aided design software, then the CAD drawing is converted for 3D systems in 1987 for use by its stereo lithography apparatus (SLA) machines. Here we can customize various aspects of design such as layer thickness, outer finish, temperature, etc. So once the STL file is generated, the object is ready to the printed. The second important step is printed. The STL file is fetched into the printer and according to the layers, the machine starts out laying the plastic out layer by layer. The layers are automatically mold to get the final shape. The final phase consist of finishing the product.

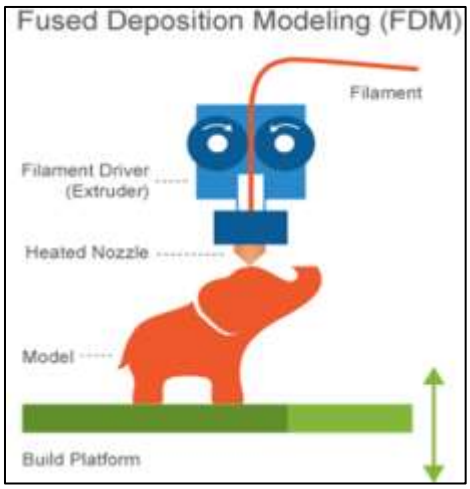

Fig. 2: Working of 3D Printer

B. 3D Printer

3D Printer; A 3D printer is a computer aided manufacturing (CAM) device that creates three dimensional objects. However, instead of printing the output on paper a3D printer builds a three-dimensional model out of a custom material.
There are many 3D printing technologies or some many call them different type of 3D printer.

- Stereo lithography
- Digital light processing (DLP)
- Electronic beam additive manufacturing (EBAM)
- Laminated object manufacturing (LOM)
- Fused deposition modeling (FDM)

Now here arise a question what materials do 3D printers use? 3D printer can use a wide range of material like plastic, resins, ceramics, titanium, bronze, stainless silver, gold etc. The most popular material used in plastic.

1) Stereo Lithography

Stereo lithography (SL), is one of several methods used to create 3D-prined objects. It's the process by which a uniquely designed 3D printing machine, called a stereo lithography apparatus (SLA) converts liquid plastic into solid objects.

The process was patented as a means of rapid prototyping in 1986 by Charles Hull, Co-founder of a 3D systems.

2) Digital Light Processing (DLP)

Digital light processing is a 3D printing process where a projector is used to cure photopolymer resin. Very similar to SLA where the very difference is that instead of a UV laser to cure the photopolymer resin, a safelight (light bulb) is used. Objects are created the same as SLA with the object being either pulled out of the resin which creates space for the uncured resin at the bottom of the container and to form the next layer of the object or down into the tank with the next layer being cured on the top.

Objects that are printed with digital light processing have less visible layers versus other processes such as FDM/FFF. Compared with SLA, DLP can have faster build speeds due it a single layer being create in one singular digital image whereas with SLA, the UV laser has to scan the vat with a single point (trace out the object layer).

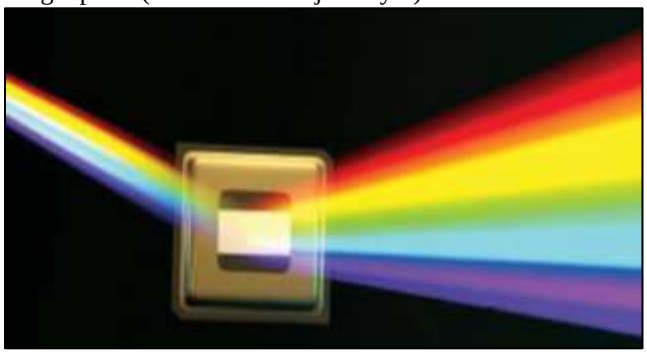

Fig. 3: Digital Light Processing (DLP)

3) Electronic Beam Additive Manufacturing (EBAM)

Electronic Beam Additive Manufacturing (EBAM) is an innovative additive manufacturing (AM) Process in which metal powder of filament is completely melted by a concentrated beam of electrons. Production in a vacuum chamber ensures that oxidation will not compromise highly reactive materials like titanium. Vacuum production is also required so electrons don't collide with gas moleclues.

Not long ago, most EBM projects merely illustrated the considerable possibilities of the AM technology is more fully realized as it used to print components used in demanding aerospace, automotive, defense, petrochemical and medical applications.

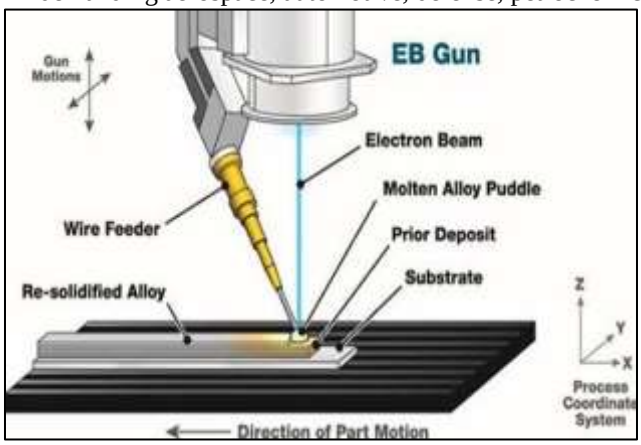

Fig. 4: Electron Beam Additive Manufacturing

4) Laminated Object Manufacturing (LOM)

Laminated Object Manufacturing is a rapid prototyping system developed by Helisys Inc.(cubic technologies is now the successor organization of Helisys) In it, layers of adhesive-coated paper, plastic, or metal laminates are successively glued together and cut to shape with a knife or laser cutter. Objects printed with this technique may be additionally modified by machining and drilling after printing. Typical layer resolution for this process is defined by the material feedstock and usually ranges in thickness from one to a few sheets of copy paper.

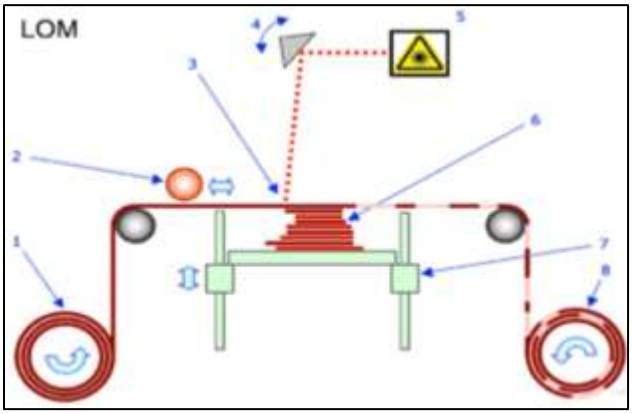

Fig. 5: Laminated Object Manufacturing

C. *Fused Deposition Modeling (FDM)*

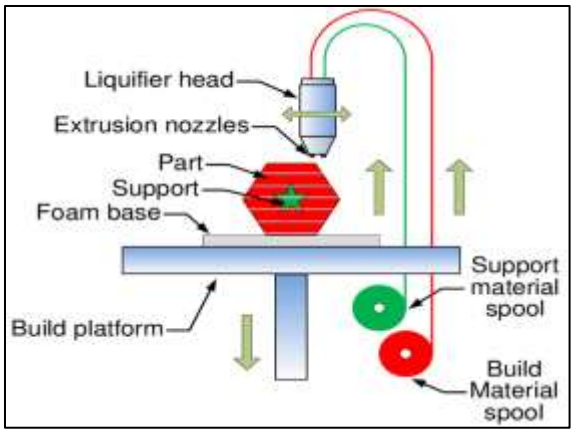

Fig. 6: Fused Deposition Modeling

There are several different methods of 3D printing, but the most widely used is the process known as fused deposition modeling. FDM printers use a thermoplastic filament, which is heated to its melting point and then extruded, layer by layer, to create a three dimensional object. The technology behind FDM was invented in the 1980s by Scott Crump, Co-founder and chairman of stratasys Ltd, a leading manufacturer 3D printers, one 3D Printing organizations have since adopted similar technologies under different names. The brooklyn based company market bot (now owner by stratasys), was founded on a nearly identical technology known as fused filament fabrication (FFF).

III. THE PAST, PRESENT AND FUTURE OF 3D PRINTING

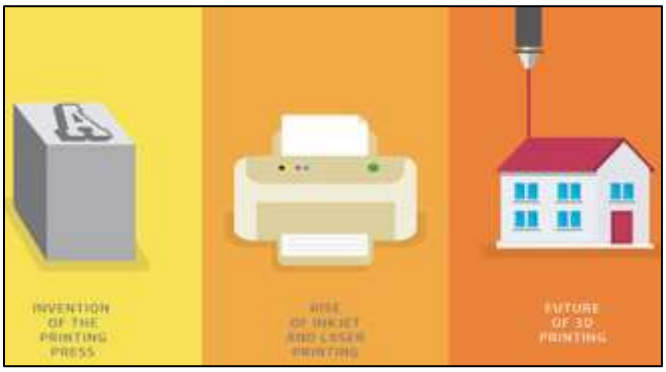

Fig. 7: Innovation of Printing

A. *The History of 3D Printing*

The first glimmer of 3D printing technology emerged in the 1980s, at the time refer red to as" rapid prototyping" (RP) technologies. In 1983s Charles (Chuck) Hull invented a stereo lithography apparatus (SLA), and three year later, confounded the 3D systems corporation, which is still around today. The first commercial RP system hit the market in 1987s and was first sold in 1988s.

A number of other inventors were working in a similar area, In 1989s, Carl Deckard of the University of Texas filed a patent for the selective laser sintering (SLS) RP process, and scott crump, co-founder of stratasys, filed a patent for fused deposition modeling (FDM). These pinoneers, as well as others set off a wave of RP companies in the early 1990s that continued to introduce new technologies, which mostly focused on industrial applications. 'Additive Manufacturing' remained a largely siloed sector until medical researchers began exploring 3D a printing opportunities, printing synthetic scaffolds of a human bladder for successful implantation a human patient 1999s. Then, as early as 2004s, the Rep-Rap open-source project was created to develop the first self-replicating 3D printer. The first commercially available 3D printer hit the market in January 2009s, followed closely by market bot, which began shipping desktop 3D printer kits later that year.

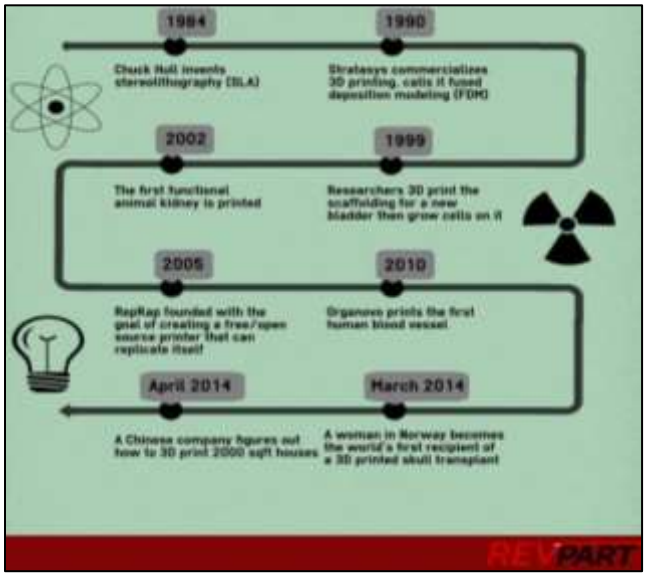

Fig. 8: History of 3D Printing

More accessible 3D printers (that give you full freedom of printing) kicked off a new era in the history of the 3D printing, entering the mainstream. Recent years unfurled a renaissance in 3D prining, yielding everything from Urbee's 3D-printed car in 2010s to 3D printed chocolate in 2011s. Amazon's 3D printing store launched in 2014s, and advancements in medicine, manufacturing and other industries continue to accelerate.

B. 3D Printing Today

The past year has been an exciting time for 3D printing. The technology has spread to new sectors and been applied in new ways to meaningfully transform people's lives.

1) Art

In November 2015s, the unseen art project initiative launched, an open source platform that recreates classical art painting in 3D. It aims to make fine 3D-printing technology to create replicas of masterpieces that people can touch. Someone who is blind or visually impaired who was never able to see Mona Lisa could print a 3D version and experience the art for the first time.

2) Shelter

2016s also market the first 3D-printed home, an innovation that could prove revolutionary in marketing affordable housing more accessible. In Chine, a 3D printed mansion was completed in 45 days and the creators claim it's durable enough to withstand an 8.0 earthquake. Singapore plans 3D-printed public housing in an effort to decrease dependence on foreign labor and build homes for its elderly community.

3) Transportation

Smart-Tech predicts that 3D printing in the automotive industry will be worth $1.1 billion a year by 2019s, and innovative companies like koenigsegg are using 3D printing to create cars of unprecedented acceleration and performance. Audi is using 3D printing to produce spare parts on-demand, which allows the company to disrupt its internal supply chain.

4) Medicine

A medical team from the Prince of Wales hospital I Hong-Kong created a 3D printed custom implant to reconstruct a man's pelvis, following this surgery for a pelvic tumor. Scientific American reports that 3D printing is allowing scientists to build" complex biomimetic hands" that don't just provide motion, but also enable the highly valuable sense of touch. Wake forest baptist medical center has pulled into the lead in successful 3D-printed tissue implantation, announcing earlier this year that they printed ear, bone, and muscle structures and implanted them into animals.

C. Tomorrow's Printing Innovations

The next step in medicine is 3D-print organs. The team at the wake forest institute for regenerative medicine, under the direction of Dr. Anthony Atala, is nearing completion of an integrated Tissue and organ printing system (ITOP) an important step toward printing living tissue and organ structure for surgical implantation.

With vehicles, fully functional, 3D-printed high-performance cars are still in the early days, and the future will see companies like koenigsegg. Local motors and blades produce lightweight" Supercars" at scale. In construction, companies like INNOPRINT will use 3D printing to rapidly build emergency housing, which will transform the traditional approach to disaster relief.

The reality is that many of the most exciting 3D printing innovations are still in the early prototyping stage. Down the road(who knows how close, or how far), We will see businesses 3D print faster and at a greater scale We will see surgery transformed by the capacity to3D print human body parts and organ donor lies shortened by the availability of customized, Printed organs. We will

see social entrepreneurs leverage 3D printing to improve their delivery bof products and services to the people who need them the most. One thing is certain; the history of 3D printing is at a tipping point.

IV. COMPARISION BETWEEN 3D PRINTING & TRADITIONAL METHODS OF MANUFACTURING

The main difference between 3D printing and traditional manufacturing.

- Traditional manufacturing, as the act of converting raw materials into finished products by using manual or mechanized transformational techniques. The purpose of such activities is to add value to achieve targeted objectives, which don't preclude society's overall interests.
- 3D printing or additive manufacturing is a process of 3D solid objects from a digital file.
- The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.
- Using only one type of polymers usually (ABS polymer) in 3D but in other processes you can use what you want.
- The 3D printed parts are not strong, they are just for sake of prototyping.
- 3D can do complex shapes with less cost than the traditional machining.
- Traditional machining needs skillful workers but the 3D printing need just the CAD file of the product.
- 3D printing heat/temperature is controlled or at minimum which closely resembles cold manufacturing found in nature say for example spider making a web, in traditional manufacturing say plastic moulding, There is a lot of heat/temperature involved.
- 3D printing has no manufacturing leftover waste or at least at minimum when compared to traditional manufacturing.

V. CONCLUSION

3D printing is one of the fastest growing fields in additive manufacturing, 3D printing being used in multiple disciplines irrespective of their application by personalizing according to the need of their particular discipline. 3D printing is used in applications like medical, civil, electrical etc. 3D printing helps in creating prototypes in short duration of time which can be varified and helps in shortening lead times.

This paper has reviewed the importance of 3D printing in various applications in mechanical engineering.

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