3-D Printing Technology

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***Abstract*- This paper describes about the new revolutionary technology which is 3D Printing or 3DP. Being medical, education, fashion or any other field, it is changing everything from a toy car to a space jet. This tells about the general algorithm, area of applications and the process involved in it. Various technologies used for the purpose are also explained briefly and future aspects are also projected briefly.**

I. INTRODUCTION

3D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as rapid prototyping, is a mechanized method whereby 3D objects are quickly made on a reasonably sized machine connected to a computer containing blueprints for the object. The 3D printing concept of custom manufacturing is exciting to nearly everyone.

This revolutionary method for creating 3D models with the use of inkjet technology saves time and cost by eliminating the need to design; print and glue together separate model parts. Now, you can create a complete model in a single process using 3D printing. The basic principles include materials cartridges, flexibility of output, and translation of code into a visible pattern.

3D Printers are machines that produce physical 3D models from digital data by printing layer by layer. It can make physical models of objects either designed with a CAD program or scanned with a 3D Scanner.

II. TECHNOLOGIES USED

Stereo lithographic 3D printers (known as SLAs or stereo lithography apparatus) position a perforated platform just below the surface of a vat of liquid photo curable polymer. A UV laser beam then traces the first slice of an object on the surface of this liquid, causing a very thin layer of photopolymer to harden. The perforated platform is then lowered very slightly and another slice is traced out and hardened by the laser. Another slice is then created, and then another, until a complete object has been printed and can be removed from the vat of photopolymer, drained of excess liquid, and cured.

Fused deposition modeling - Here a hot thermoplastic is extruded from a temperature-controlled print head to produce fairly robust objects to a high degree of accuracy.The model to be manufactured is built up a layer at a time. A layer of powder is automatically deposited in the model tray. The print head then applies resin in the shape of the model. The layer dries solid almost immediately. The model tray then moves down the distance of a layer and another layer of power is deposited in position, in the model tray. The print head again applies resin in the shape of the model, binding it to the first layer. This sequence occurs one layer at a time until the model is complete.

Digital Light Processing is another 3D Printing process very similar to stereolithography. The DLP technology was created in 1987 by Larry Hornbeck of Texas Instruments and became very popular in Projectors production. It uses digital micro mirrors laid out on a semiconductor chip. The technology is applicable for movie projectors, cell phones and 3D printing.

Selective Laser Sintering (SLS) is a technique that uses laser as power source to form solid 3D objects. This technique was developed by Carl Deckard, a student of Texas University, and his professor Joe Beaman in 1980s. Later on they took part in foundation of Desk Top Manufacturing (DTM) Corp., that was sold to its big competitor 3D Systems in 2001. As was stated previously, 3D systems Inc. developed stereo lithography, which in some way is very similar to Selective Laser Sintering. The main difference between SLS and SLA is that it uses powdered material in the vat instead of liquid resin as stereo lithography does.

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 so true as SLM process fully melts the metal material into solid 3D-dimentional part unlike selective laser sintering. The history of SLM started with German research project held by group of Fraunhofer Institute ILT in 1995.

Electronic Beam Melting is another type of additive manufacturing for metal parts. It was originally coined by Arcam AB Inc. in the beginning of this century. 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 is pretty similar.

Laminated object manufacturing (LOM) is one more rapid prototyping system that was developed by the California-based company Helisys Inc. 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.

III. ALGORITHM

The algorithm used in the Inkjet 3-D Printing is depicted in the figure mentioned below.

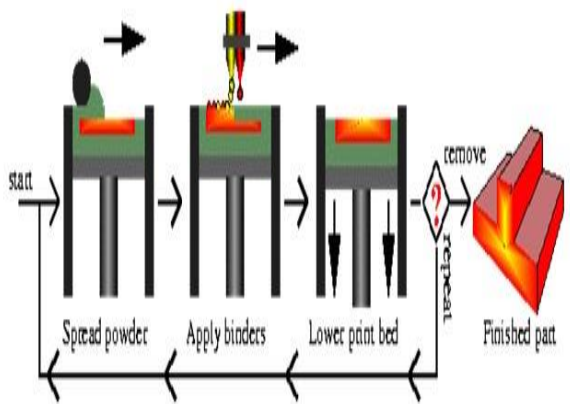

Figure 2: Algorithm of 3-D Printing

A 3-D prototype of a desired object is created in three basic steps and these steps are:

• Pre-Process
• 3-D Printing
• Post-Process

The 3D printer runs automatically, depositing materials at layers ~.003 which is definitely not too much thick. This is roughly the thickness of a human hair or sheet of paper. The time it takes to print a given object depends primarily on the height of the design, but most designs take a minimum of several hours. The average cost for printing a full color prototype is somewhere between 50 -100 $.

IV. FUTURE SCOPE

3D printing has a bright future, not least in rapid prototyping (where its impact is already highly significant), but also in medicine the arts, and outer space. Desktop 3D printers for the home are already a reality if you are prepared to pay for one and/or build one yourself.

3D printers capable of outputting in color and multiple materials already exist and will continue to improve to a point where functional products will be able to be output. With effects on energy use, waste reduction, customization, product availability, medicine, art, construction and sciences, 3D printing will change the manufacturing world as we know it.

V. FIELDS OF APPLICATION

- Medical and Dental
- Maritime Industry
- Chemical Industry
- Aeronautics
- Automotive
- Robotics
- Optics
- Education
- Architecture
- Art/Design/Sculpture
- Fashion/Textile Industry
- Food Industry
- Jewellery

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