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3D Paper Printing Technology

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***ABSTRACT*:** This report presents an overview of '3D printing technology' which is the revolutionary subject for design world's requirement. With the advancement and acceptance of Concurrent Engineering to speed up and improve product development process it require a systematic approach to the integrated, simultaneous design of products and their related processes, including manufacture and support. The term rapid prototyping (RP) refers to a class of technologies that can automatically construct physical models from Computer-Aided Design (CAD) data. Those "3D printers" allow designers to quickly create tangible prototypes of their designs, rather than just two dimensional pictures. Processes in this area are continuing to evolve but typically build objects in a series of layers between 0.01 and 1.0mm thick. This allows for the precise construction of complex geometry, which enables designers to explore forms that would previously happen. The report covers the basic processes, types and applications of 3D printing technology and put a future vision that the 3D printing Technology will revolutionize the manufacturing processes.

Keywords- Computer-Aided Design (CAD), layer printing, simultaneous design.

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.3D printers are generally faster, more affordable, and easier to use than other additive manufacturing technologies. However, the term 3D printing is increasingly being used to describe all additive manufacturing processes. 3D printers offer product developers the ability to print parts and assemblies made of several materials with different mechanical and physical properties, often in a single build process. Advanced 3D printing technologies yield models that can serve as product prototypes.

Since 2003 there has been large growth in the sale of 3D printers. Additionally, the cost of 3D printers has declined. The technology also finds use in the fields of jewelry, footwear, industrial design, architecture, engineering and construction (AEC), automotive, aerospace, dental and medical industries, education, geographic information systems, civil engineering, and many others A large number of competing technologies are available to do 3D printing. Their main differences are found in the way layers are built to create parts. Some methods use melting or softening material to produce the layers, e.g. selective laser sintering (SLS) and fused deposition modeling (FDM), while others lay liquid materials that are cured with different technologies. In the case of laminated object manufacturing, thin layers are cut to shape and joined together. Each method has its advantages and drawbacks, and consequently some companies offer a choice between powder and polymer as the material from which the object emerges. Generally, the main considerations are speed, cost of the printed prototype, cost of the 3D printer, choice and cost of materials and color capabilities.

The new TLC method was developed by Gerald M. La Porte with utilizing a solvent system(80% n-hexane, 3% methyl ethyl ketone, and 17% ethyl acetate) that is capable of producing excellent resolution. examined 81 different samples included a total 54 printer samples for improving the resolution of image. One method of 3D printing consists of an inkjet printing system. The printer creates the model one layer at a time by spreading a layer of powder (plaster, or resins)

and inkjet printing a binder in the cross-section of the part. The process is repeated until every layer is printed. This technology is the only one that allows for the printing of full colour prototypes. This method also allows overhangs. In digital light processing (DLP), a vat of liquid polymer is exposed to light from a DLP projector under safelight conditions.

Standard applications include design visualization, prototyping/CAD, metal casting, architecture, education, geospatial, healthcare and entertainment/retail. Other applications would include reconstructing fossils in paleontology, replicating ancient and priceless artifacts in archaeology, reconstructing bones and body parts in forensic pathology and reconstructing heavily damaged evidence acquired from crime scene investigations. More recently, the use of 3D printing technology for custom footwear was suggested by Anthony Staros .According to author. Since foot problems are quite common even for the people who exhibit no clinical pathology, there needs to be an improved way to provide footwear for the general population. If the old methods of the cast production are replaced by the steriophotographic scheme with computer aided design and computer control manufacturing, then the general population's requirement also be satisfied. IT is mentioned about the pressure mapping pathology technique which helps for to display how shape modifications affect the critical force on pattern of the foot. Production Artists have been using 3D printers in various ways. During the 2011 London Design Festival, an installation, curate by Murray Moss and focused on 3D Printing, took place in the Victoria and Albert Museum (the V&A).

II. LITERATURE SURVEY

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 resonably sized machine connected to a computer containing blueprints for the object.The 3D printing concept of custom manufacturing is esciting to nearly everyone.

Research described in Parraman et al.(2008) included an evaluation of the colour output of the Zcropspectrum 510 powder-binder 3D printer. This involved the production of 3D printed colour charts and samples, which were finished by wax infiltration. here colour chats were printed on flat (horizontal,upward facing) surfaces, and also vertical faces of a cube.

III. METHODS

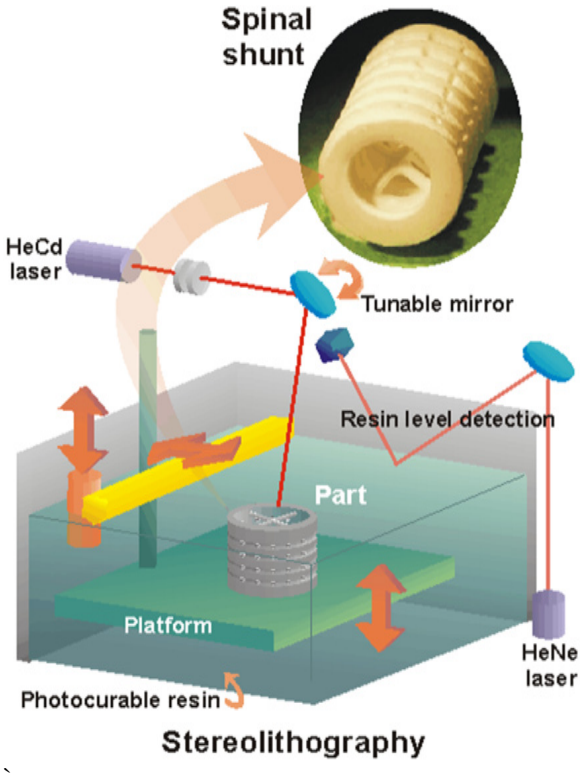
A number of competing technologies are avialable to do 3D printing. their main differences are found in the way layers are built to create parts. some methods use melting or softening material to produce the layers,e.g. selective laser sintering (SLS) and fused deposition modeling (FDM), while others lay liquid materials that are cured with different technologies,i.e stereolithography(SLA). In the case of laminated object manufacturing (LOM), thin layers are cut to shape and joined together (i.e paper, polymer,metal). Each method

1.Stereo lithography

stero lithographic 3D printers (known as SLAs or stero 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, abd cured.

fused deposition modeling-here a hot thermoplastic is extruded from a temperature-controlled prin head to produce fairly robust objects to a high degree of accuracy.



2.Selective laser sintering (SLS) –

This builds objects by using a laser to selectively fuse together successive layers of a cocktail of powdered wax, ceramic, metal, nylon or one of a range of other materials. The process is similar to stereo lithography replacing the UV light with a

laser and a vat of liquid with a powdered base. the major benefit of SLS is the ability to produce parts in a variety of materials ranging from plastics to ceramic to metals. In some case SLS technology can be used in lieu of more expensive tooling processes. The Sinterstation by 3D systems is an example of this technology in practice.

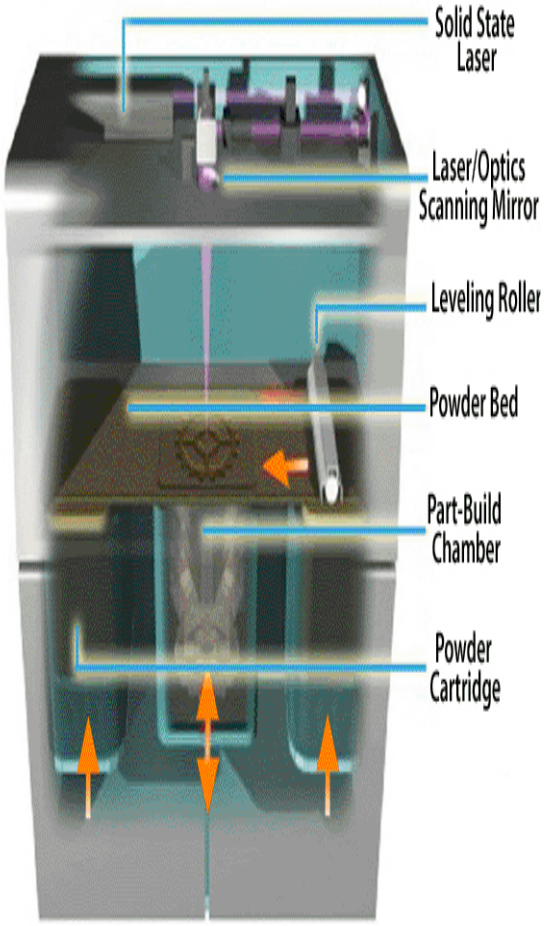


FIG: SELECTIVE LASER SINTERING

3 Fused deposition modeling (FDM)

Fused Deposition Modeling (FDM) creates models by heating and extruding a filament of plastic material. Fused deposition modeling(FDM) is an additive manufacturing technology commonly used for modeling, prototyping,and production application. objects created with an FDM printer start out as computer -aided design(CAD) files. Before an object can be printed,its CAD file must be converted to a format that a 3D printer can understand usually. STL format. FDM printers use two kinds of materials, a modeling material, which constitutes the finished object,and a support material, which acts as a scaffolding to support the object as its being printed during printing, these materials take the form of plastic threads ,orfilament,which are unwound from a coil and fed through an extrusion nozzle. The nozzle melts the filaments and extrudes them onto a base, sometimes called a build platform or table. Both the nozzle and the base are controlled by a computer that translates the dimensions of an object into X,Y and Z coordinates for the nozzle and base to follow during printing.

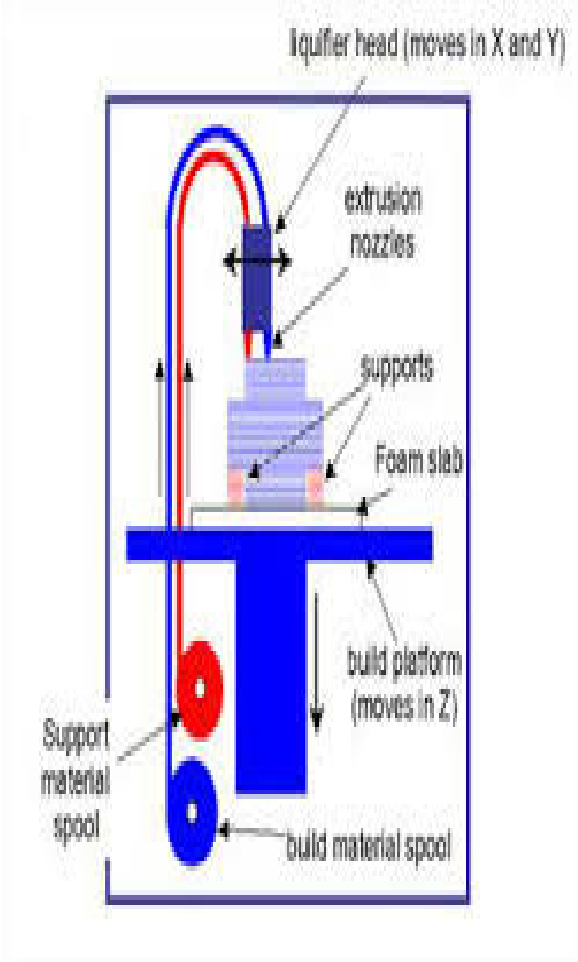


FIG: FUSED DEPOSITION MODELING

4. INKJET 3D PRINTING - It creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and inkjet printing binder in the cross-section of the part. It is the most widely used 3-D Printing technology these days and the reasons beyond that are stated below.This technology is the only one that 1.Allows for the printing of full color prototypes. 2Unlike stereo lithography, inkjet 3D printing is optimized for speed, low cost, and ease-of-use.3No toxic chemicals like those used in stereo lithography are required.4Minimal post printing finish work is needed; one needs only to use the printer itself to blow off

surrounding powder after the printing process. Allows overhangs and excess powder can be easily removed with an air blower.

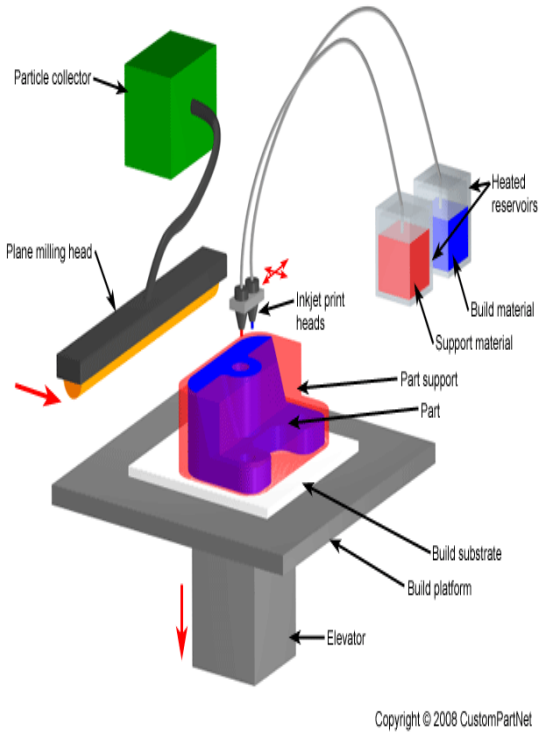


FIG: INKJET 3D PRINTING

IV. COMPARISON PRINTING PROCESSES-

Process	Description	Advantages	Disadvantage	Applications
Selective Laser Sintering	Laser fusion in a powder bed	Strong Complex parts Large build volume Parts can be stacked in build volume Living hinges and snap features possible	Grainy surface finish	Electronics housing Mounts Custom consumer products Aerospace hardware
Stereo lithography	UV laser scanning vat polymerization	Fine detail Smooth surface finish	Weak parts Susceptible to sunlight and heat	Medical/dental products Electronics casings Investment casting patterns Art
Fused Deposition Modeling	Extruded layers of thermoplastic	High part strength Low cost	Poor surface finish Slow printing	Electronics housing Mounts Custom consumer products
Injection Molding	Material mixed and forced into a mold	Broad material selection High volume High tolerance Great surface finish	High start-up cost Long lead time Thin walled parts only	Automotive Aerospace Electronics Packaging Containers

Table : comparison of printing processes

V. WORK FLOW

The workflow can be easily understood with the help of the flowchart given below.

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

1. Pre-process 2. 3D printing 3. post process

Pre-process: Pre-process includes the design of object on CAD software.3D models are designed in software is the pictorial from of object printing.

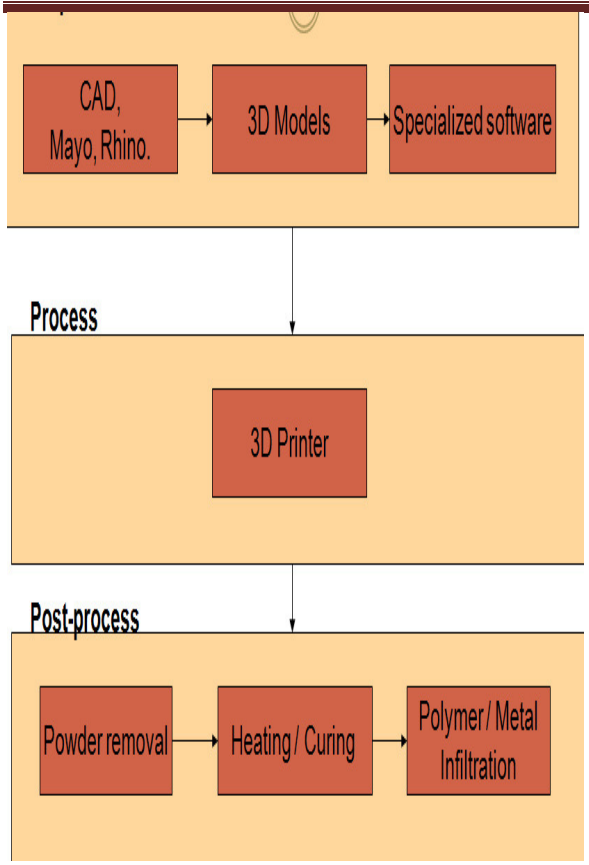


Table: Flow chart of printing Technology

VI. PROCESS

1 CAD Preparation (Pre-Process):
computer -aided design (CAD),also known as computer-aided design and drafting (CADD),is used to prepare a 3D or 2D model of the desired object modern CAD packages can also frequently allow rotations in three dimensions,allowing viewing of a designed object from any desired angle. Most 3D printers require file (typically .stl format) to print.Additionally,we need to modify the design to make up for limitations of the printer and build material.

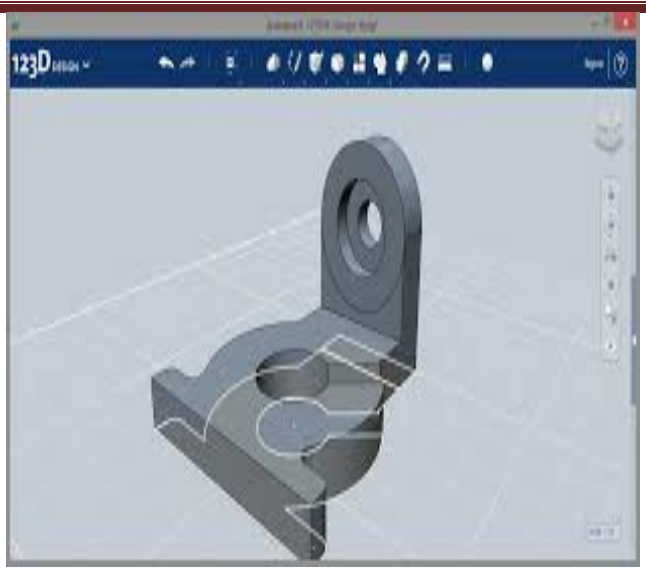
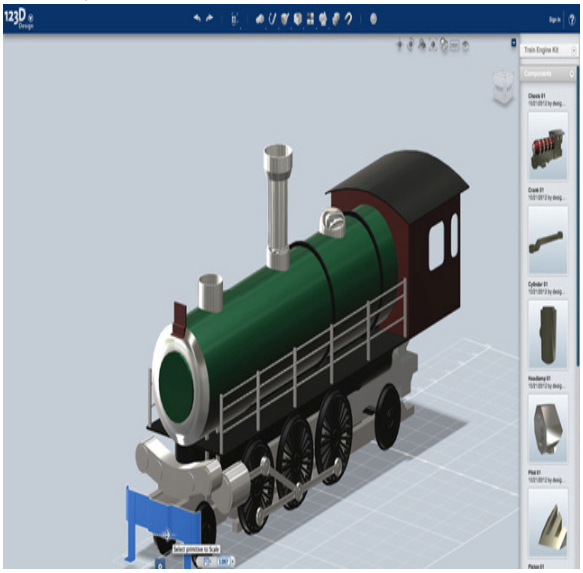


Fig: CAD software

The standard data interface between CAD software and the machines is the STL file format. An STL file approximates the shape of a part or assembly using triangular facets. Smaller facets produce a higher quality surface. VRML or WRL files are often used as input for 3D printing technologies that are able to print in full color.

2 3D Printing: The 3D printer runs automatically,depositing materials at layers~.003″ 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$



3 Cleaning 3D Printouts (Post-Process):
Every 3D printer uses some sort of material to support parts of the design that have an overhang. Some printers use a loose powder which can be blown off and reused in future models.

4 Powder Removal:

Powder removal is the important process in 3d printing as the printed object is not in a desired dimensions. There are several techniques that are used for removing powder like as with the help of wire brush, by using blowers etc. Removed powder is reused for the next printing process, which saves the material cost. Operator should take care against the small metal particles will not enter into body organs. Otherwise it will leads to health problems.

5 Heating:

Heating of the object for increasing it's strength is essential. Objects are heated at a temperature 400 c - 500 c in furnace or oven. It is kept inside for 15-20 mintues . Time to allow heat is depend upon the dimensions of the object.

6 Finishing Touch:

Finishing Of the printed object is last stage in the printing process. Finishing process is achieved with the help of small grinders. Material removed in the finishing process is very negligible. Finishing process requires very smart skill operator otherwise it leads to damage.

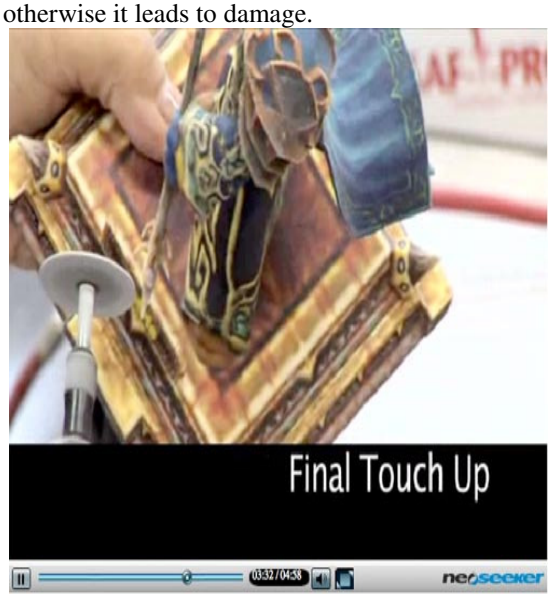


Fig: Finishing touches

VII. CONCLUSION

Nothing communicates ideas faster than a three-dimensional part or model. With a 3D printer you can bring CAD files and design ideas to life – right from your desktop.

In an age in which the news, books, music, video and even our communities are all the subjects of digital dematerialization, the development and application of 3D printing reminds us that human beings have both a physical and a psychological need to keep at least one foot in the real world. 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 also exist and will continue to improve to a point where functional products will be able to be output. As devices that will provide a solid bridge between cyberspace and the physical world, and as an important manifestation of the Second Digital Revolution, 3D printing is therefore likely to play some part in all of our futures.

VIII. FUTURE SCOPE

1.Replacement of body organs will be possible , which is called as Bioprinting.
2.Every Engineering workshop will have their own 3D printers which is replaced to lathe machines.
3.There will be stores on roads which helps customer to give object of there choice. Ex. If you go into shoe market .
3.First shopkeeper ask you for design and then deliver your choice in minutes.
4.For making space craft parts almost all international space station will use 3d printers.

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