IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

3D Printer

Pranav[1], Prasanjit Gope[1], Ranjit Ram[1], Suraj Kumar[1]

Bachelor of Engineering, Mechanical Engineering, Sri Venkateshwara College of Engineering, Bengaluru, India[1]

Abstract: 3D printing or additive manufacturing is aprocess of making three dimensional 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 untilthe entire object is created. Each of these layers can be seenas a thinly sliced horizontal cross-section of the eventual object.

Keywords: 3D Printer, Fused Deposition Moulding, Selective Laser Sintering.

I. INTRODUCTION

3D printing is also known as desktop fabricationor additive manufacturing; it is a prototyping processwhereby a real object is created from a 3D design. Thedigital 3D-model is saved in STL format and then sent to a 3D printer. The 3D printer then prints the design layer by layer and forms a real object [4]. 3D printing is a fast developing and cost-effective form of rapid prototyping. 3D Printing technology based upon common inkjet desktop printers where multiple jets deposit the print material layer after layer based on the 3D CAD data. The process of "printing" a three-dimensional object layer-by-layer with equipment. 3D printing makes it possible to make a part from scratch in just hours. It allows designers and developers to go from flat screen to exact part. 3D printing can provide great savings on assembly costs because it can print already assembled products.

With 3D printing, companies can now experiment with new ideas and numerous design iterations with no extensive time or tooling expense. They can decide if product concepts are worth to allocate additional resources. 3D printing could even challenge mass production method in the future. 3D printing is going to impact so many industries, such as automotive, medical, business & industrial equipment, education, architecture, and consumer-product industries.

II. PROCESS OF 3D PRINTING

The basic process of 3D printing are definedand simplified in the following 5 steps:**CAD Model Creation:** First, the object to be built ismodeled using a Computer-Aided Design (CAD)software package. Solid modelers, such asPro/ENGINEER, tend to represent 3-D objects moreaccurately than wire-frame modelers such asAutoCAD, and will therefore yield better results. Thedesigner can use a pre-existing CAD file or may wishto create one expressly for prototyping purposes. Thisprocess is identical for all of the RP build techniques.

Conversion to STL Format: The various CADpackages use a number of different algorithms to represent solid objects. To establish consistency, theSTL (stereo lithography, the first RP technique) formathas been adopted as the standard of the rapidprototyping industry. The second step, therefore, is toconvert the CAD file into STL format.

Slice the STL File: In the third step, a pre-processingprogram prepares the STL file to be built. Severalprograms are available, and most allow the user toadjust the size, location and orientation of the model. The preprocessing software slices the STL model into a number of layers from 0.01 mm to 0.7 mm thick,depending on the build technique. The program mayalso generate an auxiliary structure to support themodel during the build. Supports are useful for delicatefeatures such as overhangs, internal cavities, and thinwalledsections. Each RP machine manufacturersupplies their own proprietary pre-processing software.

Layer by Layer Construction: The fourth step is theactual construction of the part. Using one of severaltechniques (described in the next section) RP machinesbuild one layer at a time from polymers, paper, orpowdered metal. Most machines are fairly autonomous,needing little human intervention.

Clean and Finish: The final step is post-processing.This involves removing the prototype from themachine and detaching any supports. Somephotosensitive materials need to be fully cured beforeuse. Prototypes may also require minor cleaning and surface treatment. Sanding, sealing, and/or painting themodel will improve its appearance and durability.

III. PROCESS

The different technologies are being used in thistechnology, some of them are mentioned below:

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

A. FUSED DEPOSITION MODELING (FDM):

Fused deposition modeling (FDM) was developed by Mr. Scott Scott Crump in the late 1980s and was commercialized in 1990 by Stratasys. Fused Deposition Modeling (FDM) creates 3Dprototypes by heating and extruding a filament of plastic material. In a typical FDM system, the extrusion nozzle moves over the build platform in X and Y directions. This "draws" a cross section of an object onto the platform. When this thin layer of plastic cools and hardens, it immediately binds to the layer beneath it. Once a layer is completed, the base is lowered slightly, making way to add the next layer of plastic.

This is most widely used and affordable technology in 3D Printing. As it uses real engineering grade thermoplastics, parts built are more stronger, durable and widely used for functional testing applications. You can build parts directly into ABS, polycarbonate, nylon and various other materials. Due to its simplicity and ease of use; these machines are office friendly machines and can be installed in Design office.

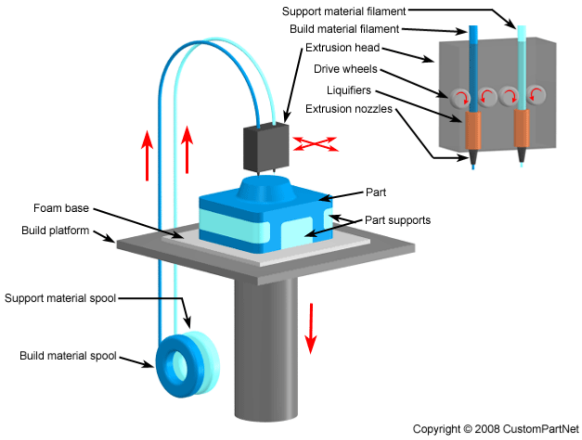

Fig. 1

B. SELECTIVE LAYER SINTERING (SLS)

Powder Based 3D PrintingSelective Laser Sintering (SLS) was developed and patented by Dr. Carl Deckard and academic adviser, Dr. Joe Beaman at the University of Texas at Austin in the mid-1980s, under sponsorship of DARPA. In Selective Layer Sintering, a computer controlled laser pulses down on the platform, tracing a cross-section of the object onto tiny particles of plastic, ceramic or glass. The laser heats the powder either to just below its boiling point (sintering) or above its boiling point (melting), which fuses the particles in the powder together into a solid form. This process continues until the entire object has been printed.SLS parts are widely used for snap-fit applications. As powder is used for printing the parts; special care needs to be taken while handling these machines. These machines cannot be used in office environment and needs a special environment.

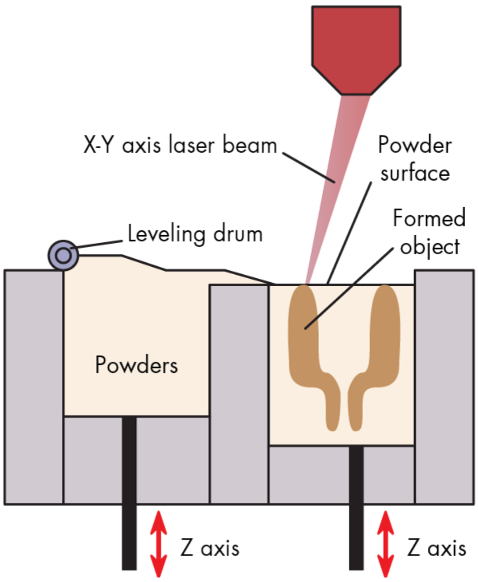

Fig. 2

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

C. STEREOLITHOGRAPHY (SLA)

Liquid Based 3D Printing the first commercial 3D printer was based on a technique called Stereolithography, invented by Charles Hull in 1986. It is also called as SLA (SteroLithographyApparatus)In Stereolithographic 3D printers, successive layers of fluid resin are hardened using UV rays or lasers. After each layer is fused, the perforated platform is lowered very slightly and another slice is traced out and hardened by the UV / laser. This process is repeated until a complete object has been printed.

This technology is widely used in jewellery industry due to its fine surface finish and accuracy. It is one of the most expensive technologies to use. Objects printed cannot be used directly as it needs post-curing operation to strengthen the parts.

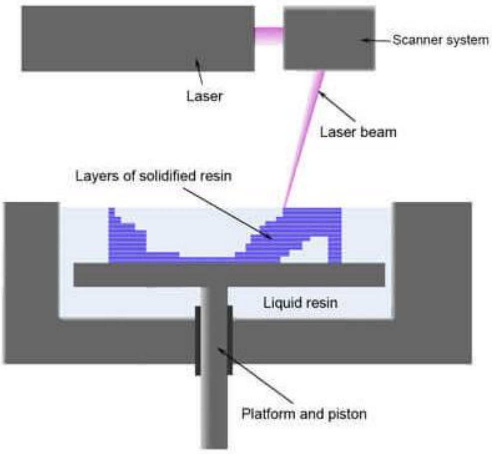

Fig. 4

D. POLYJET / INKJET 3D PRINTING

PolyJet inkjet technology works by jetting state of the art photopolymer materials in ultra-thin layers (16µ) onto a build tray layer by layer until the part is completed.Each photopolymer layer is cured by UV light immediately after it is jetted, producing fully cured models that can be handled and used immediately, without post-curing. The gel-like support material, which is specially designed to support complicated geometries, is easily removed by hand and water jetting.This technology helps us in printing rigid parts, Transparent Parts, Rubber like / Flexible parts required for prototyping applications. This is the only technology which can print multi-materials and multi-colors in a single build. Again, Stratasys is a major player in this field. The company has a significant market share for Polyjet printers in India.

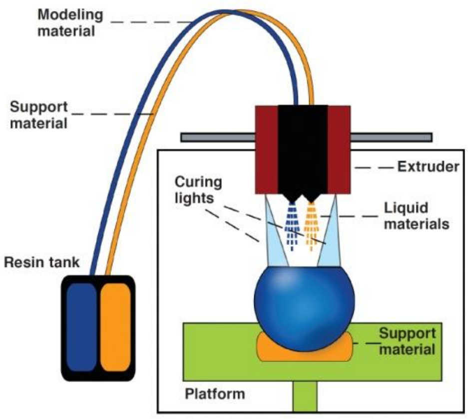

Fig. 5

IV. APPLICATION

The worldwide 3D printing industry is expected to growfrom $3.07B in revenue in 2013 to $12.8B by 2018, andexceed $21B in worldwide revenue by 2020. As it evolves,3D printing technology is destined to transform almostevery major industry and change the way we live, work, and play in the future.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

A. MEDICAL INDUSTRY

The outlook for medical use of 3D printing is evolving at anextremely rapid pace as specialists are beginning to utilize3D printing in more advanced ways. Patients around theworld are experiencing improved quality of care through 3Dprinted implants and prosthetics never before seen.

B. BIO-PRINTING

As of the early two-thousands 3D printing technology hasbeen studied by biotech firms and academia for possible use in tissue engineering applications where organs and body parts are built using inkjet techniques. Layers of living cells are deposited onto a gel medium and slowly built up to formthree dimensional structures. We refer to this field ofresearch with the term: bio-printing.

C. AEROSPACE & AVIATION INDUSTRIES

The growth in utilization of 3D printing in the aerospace and aviation industries can, for a large part, be derived from the developments in the metal additive manufacturing sector.NASA for instance prints combustion chamber liners usingselective laser melting and as of march 2015 the FAA cleared GE Aviation's first 3D printed jet engine part to fly:a laser sintered housing for a compressor inlet temperature sensor.

D. AUTOMOTIVE INDUSTRY

Although the automotive industry was among the earliest adopters of 3D printing it has for decades relegated 3d printing technology to low volume prototyping applications. Nowadays the use of 3D printing in automotive is evolving from relatively simple concept models for fit and finishchecks and design verification, to functional parts that are used in test vehicles, engines, and platforms. The expectations are that 3D printing in the automotiveindustry will generate a combined $1.1 billion dollars by2019.CTIS is provided to control the air pressure in each tyre as a way to improve performance on different surfaces. For example, lowering the air pressure in a tire creates a larger area of contact between the tire and the ground and makes driving on softer ground much easier. It also does less damage to the surface. This is important on work sites and in agricultural fields. By giving the driver direct control over the air pressure in each tire, manoeuvrability is greatly improved. Another function of the CTIS is to maintain pressure in the tires if there is a slow leak or puncture. In this case, the system controls inflation automatically based on the selected pressure the driver has set. The CTIS includes a speed sensor that sends vehicle speed information to the electronic control unit. If the vehicle continues moving at a higher speed for a set period of time, the system automatically inflates the tires to an appropriate pressure for that speed. Tire Maintenance System (TMS) Tire Maintenance System is a "smart" system for tractor trailers that monitors tire pressure and inflates tires as necessary to keep pressure at the right level. It uses air from the trailer's brake supply tank to inflate the tires.

V. FUTURE

It is predicted by some additive manufacturing advocatesthat this technological development will change the natureof commerce, because end users will be able to do much of their own manufacturing rather than engaging in trade tobuy products from other people and corporations.3D printers capable of outputting in color and multiplematerials already exist and will continue to improve to apoint where functional products will be able to be output.With effects on energy use, waste reduction, customization,product availability, medicine, art, construction andsciences, 3D printing will change the manufacturing worldas we know it.

VI. CONCLUSION

3D printing technology have reduces thecomplex process of printing into a single and simpleway. Nothing communicates ideas faster than a threedimensionalpart or model. With a 3D printer you canbring CAD files and design ideas to life – right fromyour desktop. Test form, fit and function – and as manydesign variations as you like – with functional parts. Inan age in which the news, books, music, video and evenour communities are all the subjects of digitaldematerialization, the development and application of 3Dprinting reminds us that human beings have both aphysical and a psychological need to keep at least onefoot in the real world. 3D printing has a bright future, notleast in rapid prototyping (where its impact is alreadyhighly significant), but also in medicine the arts, andouter space. Desktop 3D printers for the home arealready a reality if you are prepared to pay for one and/orbuild one yourself. 3D printers capable of outputting incolour and multiple materials also exist and will continueto improve to a point where functional products will beable to be output. As devices that will provide a solidbridge between cyberspace and the physical world, andas an important manifestation of the Second DigitalRevolution, 3D printing is therefore likely to play somepart in all of our futures.

ACKNOWLEDGEMENT

The successful completion of any task will be incomplete without completing those who made it possible and whose guidance and encouragement made my effort successful.At the very outset, firstly I would like to highly grateful towards the college SRI VENKATESWARA COLLEGE OF ENGINEERING, BENGALURU, for providing us with all the necessary help and growing up in to be engineers.

I express my sincere gratitude to **Dr. SURESHA,** principle, SVCE, Bengalauru, for providing the required faculty. I would like to convey my sincere thanks to **Dr. Shrishail Kakkeri,** Hod, Dept. of Mechanical Engineering, SVCE, Bengaluru, for the support and giving me an opportunity to work on this topic.

REFERENCES

[1] JabbarQasim Al-Maliki, AlaaJabbarQasim Al-Maliki "The Processes and Technologies of 3D Printing" Master of Electrical Engineering, Technical University of Denmark, Denmark.Oct.2015.
[2] A. Ramya, Sai leelaVanapalli "3D PRINTING TECHNOLOGIES IN VARIOUS APPLICATIONS" Mechanical, BVRIT Hyderabad College of Engineering for Women, Bachupally, Hyderabad , India
[3] Miss Prachi More "3D PrintingMaking the Digital Real"Department of Computers, PadmabhushanVasantdada Patil Pratishthan's College of Engineering,Mumbai, India, July 2013
[4] Lucas AgudiezRoitman, Michael Shanks "The new Industrial Revolution: manufacturing with 3D Printers and Polymer Materials in an Economy of Design, Innovation and Intellectual Property"HassoPlattner Institute of Design (d.school) at Stanford University, 2016.