A new Era in Additive Manufacturing Technology – 3D Printing

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ABSTRACT *-This paper deals with 3D printing and it is also called as desktop fabrication. It is a process of prototyping where by a structure is synthesized to from a 3D model. The 3D model is stored in as a STL format and after that forward0ed to a 3D printer. It can use a wide range of materials such as ABS, PLA, and composites as well.3D printing is a rapidly developing and cost optimized form of rapid prototyping. The 3D printer prints the CAD design layer by layer forming a real object. 3D printing process is derived from inkjet desktop printers in which multiple deposit jets and the printing material, layer by layer derived from the CAD 3D data. 3D printing significantly challenges mass production processes in the future. This type of printing is predicted to influence industries, like automotive, medical, education, equipment, consumer products industries and various businesses.*

KEYWORDS: *ABS, PLA, Rapid Prototyping, 3D printing*

I. INTRODUCTION

3D printing called as desktop fabrication. It is a rapid prototyping process whereby a real object can be created from a 3D design. A 3D printer machine uses a CAD model for rapid prototyping process. [1] 3D printing is called as desktop fabrication which is a process of prototyping where by a structure is synthesized from its 3d model. The 3d design is stored in as a STL format! and after that forwarded to the 3D printer. It can use a wide range of materials such as ABS,PLA, and composites as well.3D printing is one kind of rapidly developing and cost optimized form which is used for rapid prototyping. The 3D printer prints the CAD design layer by layer forming a# real object. 3D printing process is derived from inkjet desktop printers in which multiple deposit jets and the printing material,! layer by layer derived from the CAD 3D data.3D printing is diversifying and accelerating our life, letting various qualities of products to be synthesized easier and faster[2].Three dimensional (3D) printing has the ability to impact the transmission of information in ways similar to the influence of such earlier technologies as photocopying. This identifies sources of information on 3D printing, its technology, required software and applications. Along 3D printing, companies are able to extract and innovate new ideologies and various design replications with no time or tool expense. 3D printing possibly challenges mass production processes in future. 3D printing influences many industries, such as automotive, architecture, education, medical, business and consumer industries [3]. Over a century the visual world of printed scriptures has been dominated by the 2-D printing methods. Be that easy to read or comprehend but when it comes to imaging of definite and real life models it is sorely outsourced.

Any 3-D model cannot be represented and displayed easily in a 2-D workplace. The only thing worth mentioning for likable perception is the rendering of the image. This ushered in the era of the much needed idea of "3-D" printing. Basically the singular purpose for the division of 3-D printer was to prepare 3-D samples directly on the bed of the printer. It has been an effective way of manufacturing since many companies are now opting for this type of method for their production operations.

II.LITERATURE SURVEY

Early AM equipment and materials were developed in the 1980s. In 1984,Chuck Hull of 3D Systems Corp, invented a process known as stereo lithography employing UV lasers to cure photopolymers. Hull also developed the STL file format widely accepted by 3D printing software, as well as the digital slicing and infill strategies common to many processes today. Also during the 1980s, the metal sintering forms of AM were being developed (such as selective laser sintering and direct metal laser sintering), although they were not yet called 3D printing or AM at the time. In 1990, the plastic extrusion technology most widely associated with the term "3D printing" was commercialized by Stratasysunder the name fused deposition modeling (FDM).

III.APPLICATION OF 3D PRINTER

3-D printing was originally developed for rapid prototyping purposes, making less complicated physical samples. It allowed designers to identify and rectify design flaws quickly and cheaply, thereby speeding up the product development

process and minimizing commercial risks. Here are some applications of a 3D printer described below:

A. Aerospace and Automotive sector

With the help of 3-D-printed components which are used for aircrafts and parts are 70% less weighing but identically tough as conventional parts, indicating cost reduction and carbon reduction and emissions of unwanted particle. It uses less raw constituents and manufactures parts which are less weight, complicated but possess more strength [4].

B. Medicine Medical sector

It is one of the most promising areas of usage. It is being applied to face many medical situations, and develop medical research, also combining the field of "regenerative medicine". In 2012, using a 3-D printer, engineers and doctors at Hasselt successfully experimented the very first patient-specific instrument of prosthetic jaw transplant [4].

C. Rapid manufacturing

Advancements in Rapid Prototyping have presented materials those are necessary for final manufacturing, leading to the possibility of manufactured finished components and parts [5].

D. Mass customization

Many industries have provided services where people can recreate their desirables implementing simple web-based customizing software. This now enables customers to replicate cases of their mobiles. Nokia has displayed the 3D designs of their mobiles so that owners will be able to recreate their own phone case [5].

IV. PROCESS OF 3D PRINTING

3D printing process can be described and defined in the following steps:

CAD Model Creation: Initially, the item to be 3D printed is designed utilizing Computer Aided Design (CAD) software. Solid modelers, for example, CATIA, and SOLID WORKS have a tendency to represent 3-D objects more precisely than wire-frame modelers, for example, AutoCAD. This procedure is comparative for the majority of the Rapid Prototyping building methods [6]. Conversion to STL Format: The different CAD models use different methods to present solid parts. To have consistency, the stereo lithography format has been followed as the standard of the 3D printing industry. Slice the STL File: A preprocessing computer program is done which readies the STL format going to be built. Numerous programs are there, which permit the user to tweak the model. The preprocessing program cuts the Stereo lithography model into numerous layers from 0.01 mm to 0.7 mm thickness, in view of the building method. The program likewise makes an auxiliary structure to help the model amidst of building. Sophisticated structures are bound to use auxiliary support [7]. Layer by Layer Construction: The fourth step is the actual construction of the part. Using one of various techniques RP machines build one layer at a time from polymers, or powdered metal this process are shown in below fig 1 and fig 2 [7].

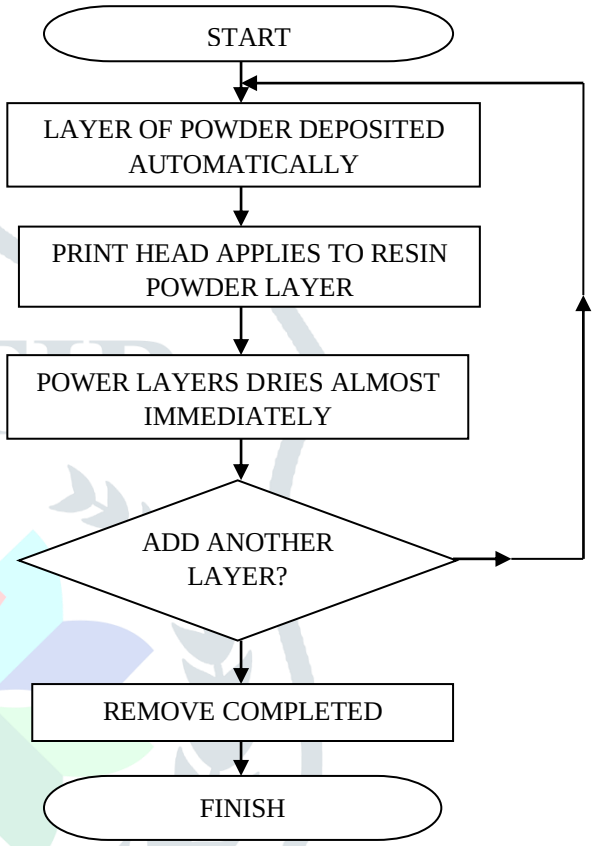

Fig 1: Flow chart of Working

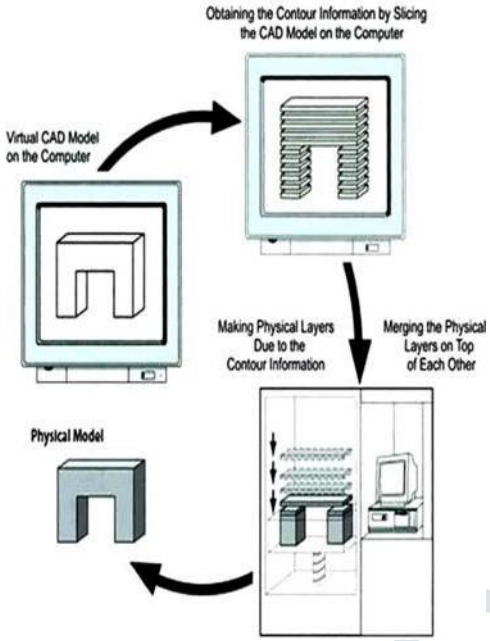

Fig 2: Working Steps/Process

V. DIFFERENT PARTS OF A 3D PRINTER

A. EXTRUDER

The 3D printer is generally assembled with a Wade's geared extruder as shown in Fig 3. This extruder contains two parts: a cold top part which feeds or provides the plastic filament and a hot bottom part which helps in melting and in turn the plastic gets extruded. These two parts, usually known as the Wade extruder (the cold part) and the hot-end (the hot part).The Wade extruder holds of a large gear which is driven by a stepper motor. This large gear drives a bolt, which extracts the plastic filament and pushes it into the hot-end where the plastic starts melting. The hot-end is generally a bolt made up of metal with a gap penetrated down the vertical pivot. This screw, otherwise called a heater barrel. At the tip of the heated barrel, the way out opening diminishes down to less than 1mm from 3mm.

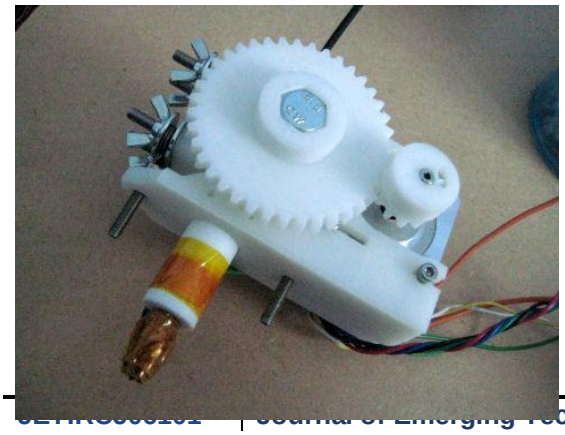

Fig3: Extruder

B. STEPPER MOTOR

There are five stepper motors used in the 3D printer are One to control the Y-axis, One to control the X-axis, Two to control the Z-axis, One to control the extruder. Controlling a bipolar stepper motor is truly muddled, particularly in the matter of smaller scale venturing mode. Uni polar stepper motors are much simpler to control however they give lesser torque given the motor size is same. Exceptionally outlined stepper motor controllers are being utilized to assume control over the troubles of directing a stepper motor. With the assistance of such controller stand out small scale step can be made. Consequently controlling of a stepper motor has been rearranged.

C. .Arduino UNO

Arduino is an open source tool for making programs that can do a way more functioning as compared to desktop computer as shown in the Fig 4. The arduino uno is a microcontroller board based on the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM output), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The functioning arduino help the programmer to stay organized and this often helps to conceptualize the program.

Fig 4: Arduino

D. Heat bed

Another vital part of a 3D printer is the heated bed. These all together cutoff the measure of twisting on the printed parts, particularly on the lower layers. Distorting is brought on because of the uneven and undistributed cooling of both external and inward segments of a printed part. This will make the cooler material to get twisted or bowed while the hot material will never. This uneven contracting will twist the straight edges and can bring about changeless disappointment in parts. Twisting is basically a significant issue for the lower layers of a part as the print plate will cool those layers at a rate much speedier than higher layers.

E. Software's Used

1. Cura

It is an open source 3D printer slicing application. It was created by David Braam who was later employed by Ultimaker, a 3D printer manufacturing company, to maintain the software. Cura was initially released under the open source Affero General Public License version 3. A 3D view of the software is shown in Fig 5.

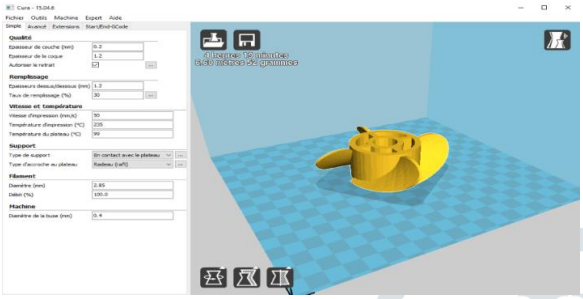

Fig 5: 3D view of a part in Cura Software

2. Pronterface

Pronterface is a 3D printing host –a program that allows direct control of 3D printers (including printing a sliced g code) through a USB cable. Pronterface is a part of printum, an open-source suite, licensed under the GNU General Public License, version 3. The view of the software is shown in Fig 2.

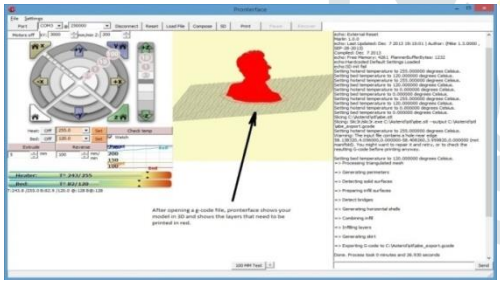

Fig 6: A view of Pronterface Software

VI RESULTS & DISCUSSIONS

After the procurement of the whole tool kit, a detailed study of all the components is made so as to gain knowledge about the working procedure and connection of each part. Then the 3d printer is structured using manual, with the help of internet and some research students. Electronics parts are connected very carefully so as to avoid any kind of accidents. After building the 3d printer it is put into working condition and some products are manufactured. Here is an image of a working 3-D printer manufacturing a product sample

VII FUTURE SCOPE

A NASA

Nothing incorporates innovation and advancement like our space program. In July 2013, NASA designed, printed, and tested rocket engine injectors by subjecting them to challenging pressures and temperatures of over 6,000 degrees F. In fall 2014, NASA has devised to launch and deliver a 3-D printer to the International Space Station, which will help astronauts to print replacement tools in space .

B BIOTECHNOLOGY

In 2012, an elderly woman in Belgium proclaimed a 3-D printed jawbone, transplanted and specially tailored to her facial structure. This year, engineers at Princeton were able to produce an ear imprint, applying a culture of animal cells and silver nano particles; the experimental version was able to read audio beyond the limit of human levels, making this a "bionic" ear. Using this method, leather could be manufactured and even meat. Engineers are working on producing non-perishable foods from powder (liquid-free) cartridges; imagine the effect that developments like these could have on global sustainability process in the future. A key idea in the flourishing field of 3-D printing is the ability for printers to

VIII CONCLUSIONS

Not all technical information about 3D printing could be shared in this introduction of the subject. Documenting the technology, very much a work-in-progress, must also recognize that not all authors agree on the likelihood of 3D printing gaining wider dissemination into the homes of individuals. Also, as a still emerging technology, 3D printing is not without its problems, such as slow printing speeds. Nevertheless, as prices are decreasing, the number of 3D printers sold worldwide has been growing steadily.

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