

Overview of 3D Printing Technology with Different Materials and Applications

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Abstract

The aim of the project is to perform thermal analysis of the 3D printed model using SOLIDWORKS 2018, create the frame using cutting and drilling machines, and combine all parts of the frame using fasteners and fire electrical connection. When the 3D printer is built, the thermal efficiency of brake discs produced from PLA (polylactic acid) and carbon filaments will be analyzed. Also, parameters that do not work in CURA software such as nozzle temperature, hot bed temperature and filling density percentage should be better to check Quality and cost of the product from the printer Printing of items will also be scheduled.

Keywords: 3D Printing, PLA, AutoCAD, CAD Design

INTRODUCTION

3D printing is the most well-known method of creating images; A method created by us can create products from 3D models. 3D designs are saved in STL format, encouraging the use of a 3D printer. Available in a variety of materials such as ABS, PLA, and hybrids, 3D printing is a rapidly growing and cost-optimized form of rapid prototyping. The 3D printer prints CAD design subcategories to create the actual product. The 3D printing process is achieved by a desktop inkjet printer where multiple planes are released and printed elements are derived one by one from CAD 3D files. 3D printing makes assembling colorful objects easier and faster, making our lives more diverse and faster.

Three-dimensional (3D) printing can affect data transfer in the same way as previous technologies such as scanning. This describes sources of information about 3D printing, its technology, and the required software and tasks. In addition to 3D printing, companies can reward and publish new ideas and colorful designs without spending time or equipment. 3D printing conceivably challenges mass product processes in future. 3D printing influences numerous diligences, similar as automotive, armature, education, medical, business and consumer diligence [2-5].

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3D PRINTER

A 3D printer is a computer-generated product that creates three-dimensional results. Like a regular printer, a 3D printer uses digital data from a computer as input. However, a 3D printer does not print these objects on paper, it uses the materials to create three-dimensional models. A 3D printer is a machine that creates physical 3D models from digital data by combining sub casts one by one. Can create a physical model of the product using CAD programs or analyze it using a 3D scanner. It is used in a variety of applications including jewelry,

footwear, manufacturing, fixtures, engineering and construction, automotive, aerospace, dental and medical testing, education and equipment.

3D printers use a process called cumulative manufacturing to create (or "print") a physical object subcaste by subcaste until the model is complete. This is different from manufacturing, where machines replace materials or remove them from the earth. Because 3D printers create models from scraps, they are more efficient and produce less waste than traditional manufacturing [6-10].

Differences between 3D printers

Different parts of 3D printers are Aluminum (6063-T5) Extrusion Channel (Ready), 5X NEMA Stepper Motor, 240 Watt Power, Mk8 Extruder, Ender bed and screen, Arduino board, M4, M5. screws, couplings, bushings, bearings, and belts, XYZ limit switches.

Aluminum (6063-T5) Extruded Channel

The frame of the extrusion channel gives the printer robust features. This frame extends to all three axes of the printer. The posts feature threaded rods and printed corridors. The edges away from the corners also have lines used to control and reconstruct the Y and Z axes. The Z-axis attaches the stepper motors to the left and right positions of this printing method.

Nema Stepper Motors

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.

Stepper Motor Controller

Controlling a bipolar stepper motor is truly muddled, particularly in the matter of lower scale venturing mode. Unipolar stepper motors are important simpler to control still they give lower necklaces given the motor size is same. Exceptionally outlined stepper motor regulators are being employed to assume control over the troubles of directing a stepper motor.

Power Supply

The power supply or PSU (power supply unit) is a metal box with a set of screw terminals that connect to the Arduino board. The electrical supply is stable in terms of the voltage required to start and move the motors and electrical components in the printer.

Ender's display

An LCD display of 90*93*40 with Used to track, record, and monitor the temperature of nozzle and heat bed also to configure settings of printer with the help of Arduino. It facilitates all activities like calibration, axes movements can be done easily with this Smart controller.

Limit Switches

While publishing an object, all three axes need to be altered from the original position to their starting one and can also be referred to as the initial position of any Cartesian robot. The axes can't move any further than zero.

To get accurate results, we need to provide three end stops for each axis. The end stop should be placed in a place where it will not move further on the spindle. To the front of the printing paper because the Z-axis position should be where the nose barely touches the printing plate.

3D Printing Process

3D printing process can be explained and described according to the following steps.

CAD design

Initially, 3D printing projects were created for practical purposes using computer-aided design (CAD) software. Product models (like CATIA) and SOLID Workshop tend to represent 3D objects more than metal models (like AutoCAD). This process is related to the rapid development of the design process.

Convert to STL format

Different CAD models use different patterns to represent the path. Stereolithography type to have thickness followed 3D printing hardness standard.

Slice the STL File

A preprocessing computer program is done which readies the STL format going to be erected. multitudinous programs are there, which permit the stoner to tweak the model. The preprocessing program cuts the Stereo lithography model into multitudinous layers from 0.01 to 0.7 mm consistence, in view of the structure system. The program likewise makes a supplementary structure to help the model amidst of structure. Sophisticated structures are bound to use supplementary support.

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.

LITERATURE REVIEW

3D printing technology first emerged in the 1980s; At the time, these were called rapid prototyping (RP) technologies. The first patent application for RP technology. The company is the founder of 3D Pots, one of the largest and most important companies in the 3D printing and rapid design industry. 3D printing craftsmanship has slowly evolved from prototypes to small batch production of customized corridors. Life Temptation has diligently become a leader in 3D printing due to the demand for implants such as dental, ear, and orthopedic services. The small size of original parts and original designs make 3D printing very important in the automotive industry. 3D printing of various materials such as thermoplastics, thermoplastics, pure perfumes, fragrances, and tableware. Currently, 3D printing has not yet matured as a final product. However, synthetic biology and nanotechnology have the power to change many models, products, and delivery systems in the coming years. These images are all solid layers, usually around 0.1 mm thick. Simply put, four 3D printers are in operation. In the beginning, we had printers that could print on molten or semi-liquid materials. Secondly, there is a printer that can change the printing. Third, there are printers that can bind or dissolve dye. Finally, there are printers that can be connected to paper, plastic or perfume waste [11-12].

Previous Research

One of the most extensively habituated delineations of advanced manufacturing involves the use of technology to ameliorate products and/ or processes, with the applicable technology being described as “advanced,” “innovative,” or “cutting edge.” For illustration, one association defines advanced manufacturing as diligence that “decreasingly integrate new innovative technologies in both products and processes. The rate of technology relinquishment and the capability to use that technology to remain competitive and add value define the advanced manufacturing sector.” [1] Another author defined World Class Foundry (read manufacturing).

Another advancement in 3D Printing happened in 2006 with the launch of an open-source design, named RepRap design [13]. The design aims at creating a tone-replicating 3D printer that has the capability to publish the utmost of its own timber objects. RepRap design uses Fused Filament Fabrication (FFF) to place down material in layers. RepRap uses ABS, Polylactic Acid (PLA), nylon, HDPE, and analogous thermos polymers to print objects. The design is an open-source design whereby all systems are released under a free software license, the GNU General Public License [14]. As we entered the 21st century, the costs of 3D printers significantly fell, allowing 3D printers to be affordable to the general request [15-16]. Printed Parts Designed on Solidworks Software (Figures 1-8).



Figure 1. Single Extrusion Channel.

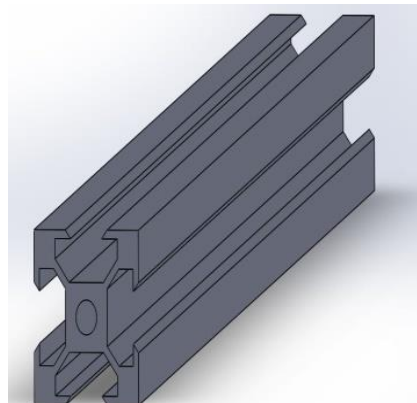


Figure 2. Double extrusion channel.

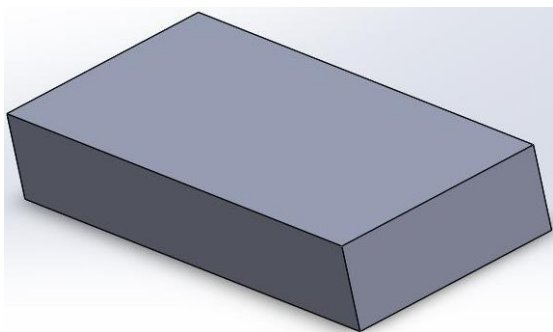


Figure 3. Power Supply.

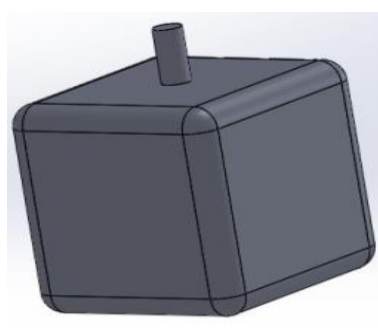


Figure 4. Stepper Motor.

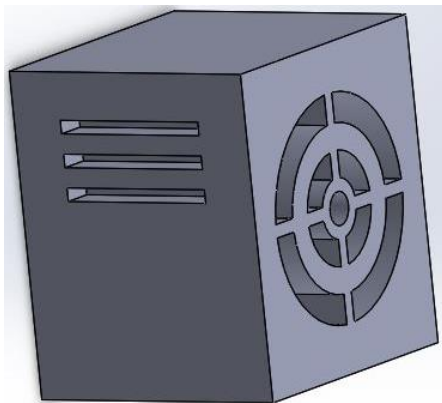


Figure 5. Hot End

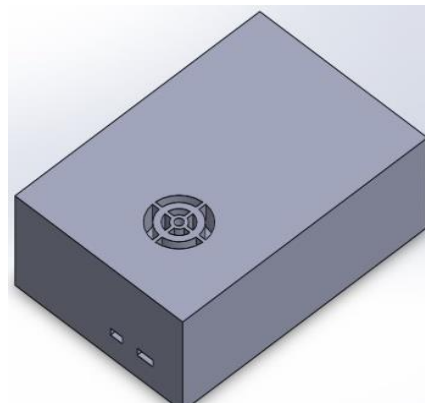


Figure 6. Arduino Board

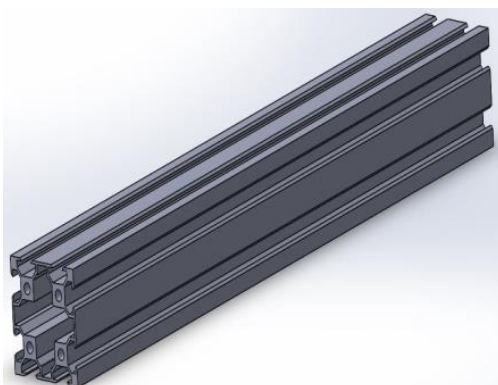


Figure 7. Base Extrusion Channel.

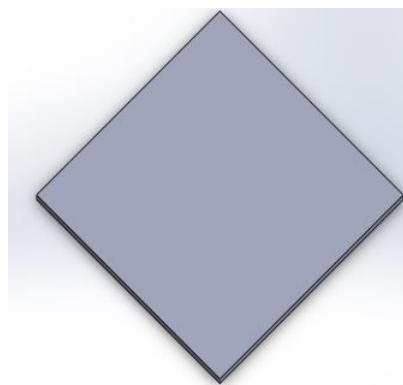


Figure 8. Platform.

In Figures 9, 10 Show Final Assembly 2D Modelling Of 3D Printer on Autocad 2013 Software.

In Figure 11 Hand Sketch of Disc Brake With Dimension.

Dimensions: Inner two circles are of dia 60 and 80mm respectively, Fixture hole of dia 10mm, Rectangular shape design on plate of 23*3mm, Outer dia of 160mm, Outer circle cuts after every 20mm inner into 33mm, an increase of 7mm height connecting outer circle.

In Figure 12 show Brake Disc Modeling by Using SolidWorks 2018 Software.

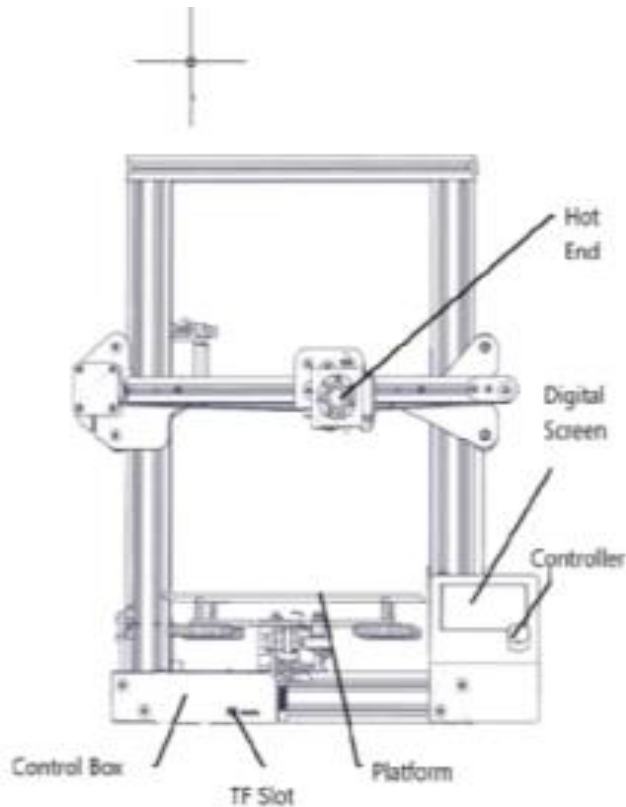


Figure 9. 2D Drawing of Printer Using AutoCAD.

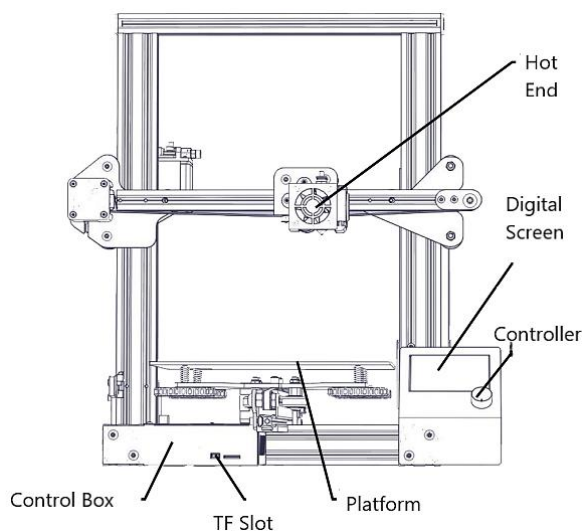


Figure 10. Drafted Image of 3D printer.

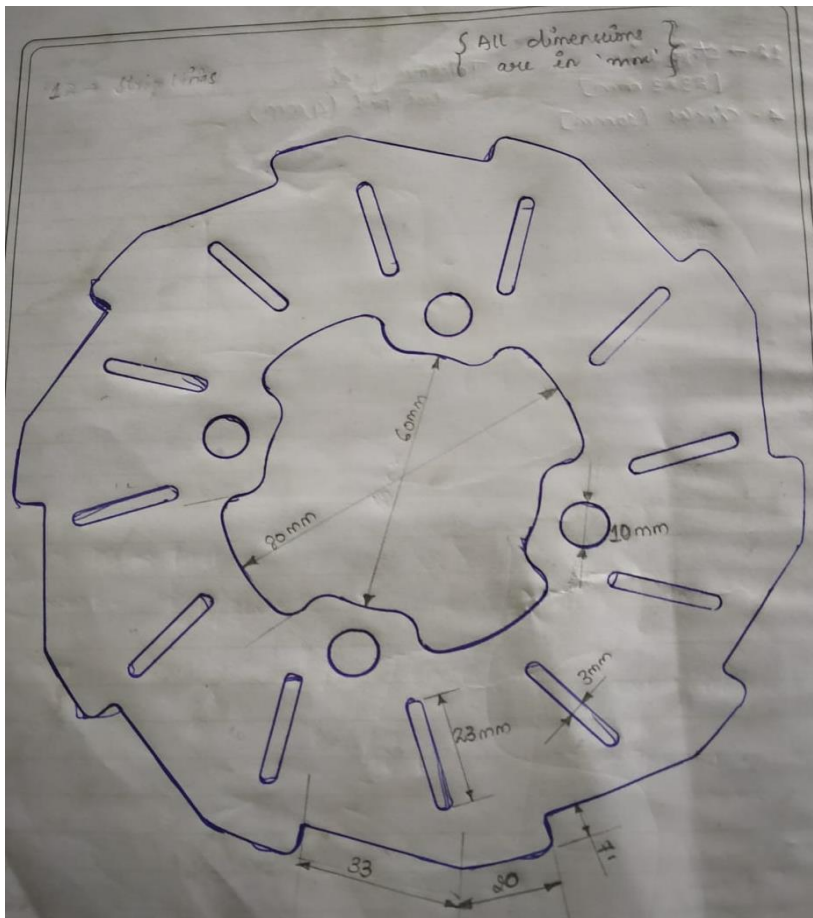


Figure 11. Free hand sketch of disc.

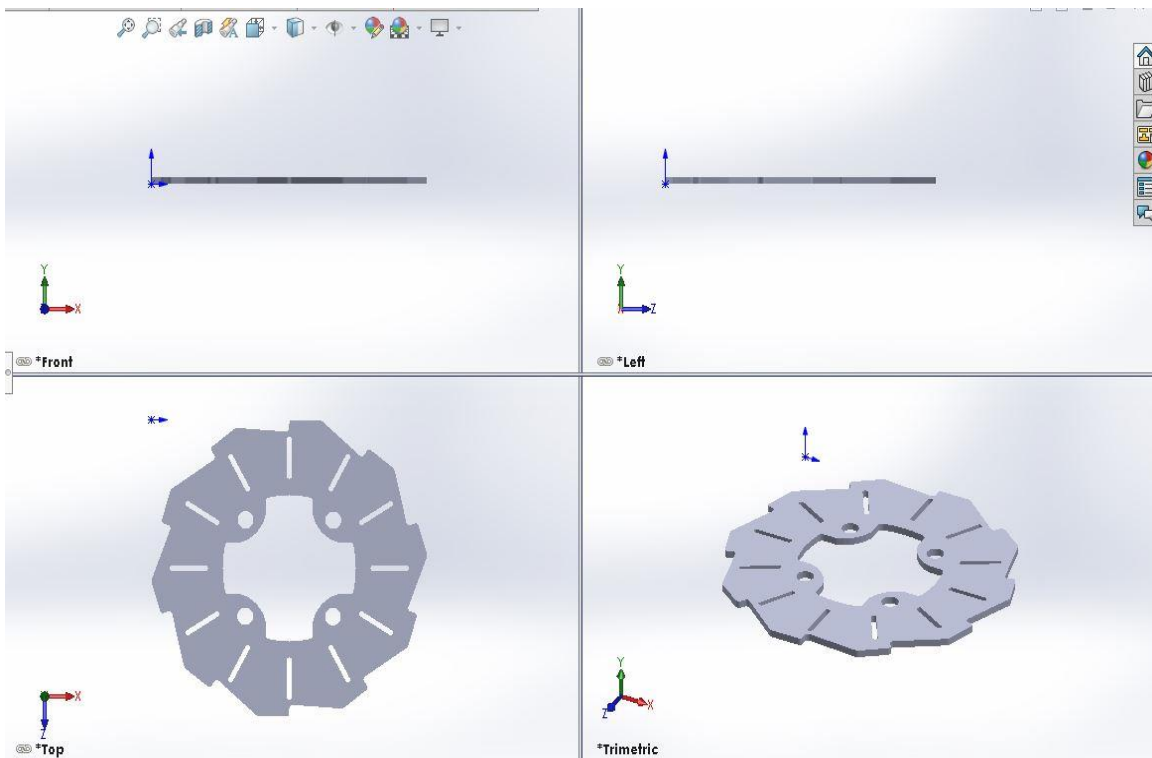


Figure 12. 3D Modeling of Brake Disc on SolidWorks.

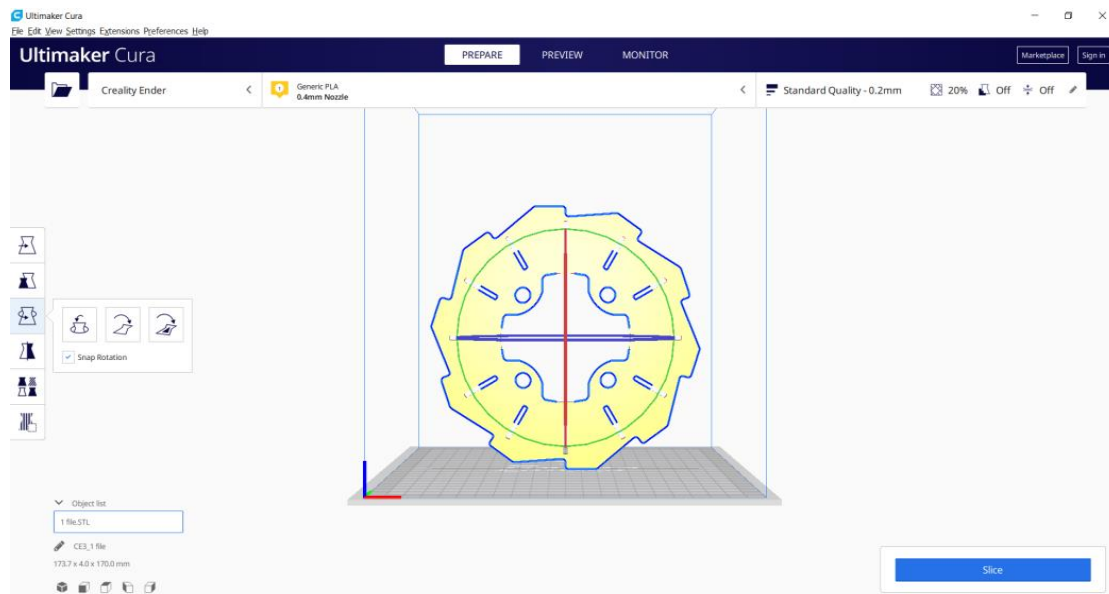


Figure 13. Disk In CURA Software.

Using CURA software again 3D solid model from SolidWorks in converted into g. Code file which contains the STL information required by the printer (Figure 13).

CONCLUSION

The aim behind this research is to analyze the 3D printed models using SOLIDWORKS and the thermal effectiveness of the printed brake disc Fabricate 3D Printer by utilizing materials which are easily available. Secondly, the 3D model of the 20mm regular cube, simple cube (i.e. each cube has 5 faces and leaves one side as the base), Cat model and 30mm batch cylinder were made using SOLIDWORKS 2018 software.

Finally, open the SolidWorks 3D model file in CURA software and change parameters such as nozzle temperature, heating bed temperature and filling the percentage of material correctly. After printing, I decided that the percentage of the product was related to the quality of the product along with the printing time by regularizing the shell thickness to 0.8 mm and the diameter to 1.75 mm for all areas.

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