

# Design and Assembly of Acrylic Hi-Tech 3D Printer

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## Abstract:

3D printing is a method of rapid prototyping and production where the materials are incorporated into one another to produce a three-dimensional object. Although 3D printing was developed in the 1980s and technology has gained widespread application in the manufacturing industry from automotive parts to machine tools, its use in the medical field is still limited [1, 2]. However, the power of 3D printing in the pharmaceutical industry is now recognized. The ability of 3D printing to produce specific drugs tailored to the needs of each patient has shown the possibility of developing personalized drugs. The technology allows volume forms to be accurately printed in shapes, sizes and textures that are difficult to produce using traditional techniques. However, there are various challenges associated with the proper use of 3D printing in the medical field that must be overcome in order to make the most of this technology. In this review, an overview of the various 3D printing technologies used to create complex dosage forms and their feasibility and limitations is provided [3, 4]. In this project work, the design and development of an integrated Cartesian 3D printer is made into sample parts using the Fused Deposition Modeling (FDM) process. Fused Deposition Modeling is an advanced manufacturing process that uses thermoplastics, ABS (Acrylonitrile Butadiene Styrene), Poly Vinyl Alcohol (PVA), polycarbonate (PC), PLA (Poly Lactic Acid).

**Keywords:** Additive Manufacturing, Design, 3D printer.

## I. INTRODUCTION

Three-dimensional printers allow you to create and modify prototype quickly by themselves, or by a company focused on faster prototyping. The ability to design, manufacture and test products, quickly five or 10 times gives designers and entrepreneurs more creative freedom. In fact, prototyping has become the leading use of 3D printers worldwide, in the automotive industry and in aerospace. The production method is known as 'Additive Production', due to the fact that instead of removing the essentials to form a component, the process adds material in successive patterns to create the desired shape [5]. The Additive Manufacturing is one of the flourishing industries today. Extra production is a non-traditional process also known as 3D printing. It is a process of transforming industrial production that enables the creation of simple, powerful, component and system components. Additional production is based on Computer Aid Design Software (CAD) or 3D object scanner to scan precision hardware that has been built or designed to fit material, layer by layer, in precise geometric shapes. Since its name has an extra layer to create things [6, 7]. When we build something in traditional ways, we later need to remove things by grinding, molding, molding and other processes. The term "3D printing" and "Rapid Prototyping" are easily used to discuss additional production; each process is actually a subset of additional production. It may seem strange to many but it has been around for decades [8, 9].

As a result, the opportunities for those who actively embrace productivity, it can be applied to many industries such as machinery and even the medical industry. Additional productivity tends to build a product, step by step, by continuously adding a different kind of drop to the relevant product value [10]. This is not the same as the traditional form of creating or attracting a product, where the essentials are cut off or removed from the main theme in order to achieve the final product. We can print instruments with 3D printing because it has the ability to make a component from a variety of materials. Here we can print the prototype of a large machine with their own structures how we will install it in the future. In this way we know the shortcomings, completeness, advantages and disadvantages of equipment and we can study its physical properties with the help of this example. The basic goal, which separates after 3D printing, is that it is a process of further production. This is also really a key because 3D printing is a very different production method based on advanced technology that builds parts, moreover, with layers on a sub mm scale. This is very different from any other traditional production techniques [11].

This project work is done for the purpose of obtaining information and transmitting it Additive Manufacturing information for future generations.

## II. METHODS AND MATERIALS USED

### Fused Deposition Modeling

In this modeling method, a 0.063inch PLA cable is inserted into the hole and the nozzle heats up to 1800C. After that, the mouthpiece begins to put things on the table. First, it creates support and then the part you want. In this project, the nozzle goes up in the z-direction, whereas, the built-in table moves with x and y. A typical FDM machine diagram is shown below. Some FDM machines use support spools to produce support structures [12]. The diameter of the nozzle is 0.75mm.

ABS is another standard plastic used for 3D printing, and is widely used in FDM 3D entry level printers in the form of filament. It is a particularly strong plastic and comes in a variety of colors. ABS can be purchased in the form of filament in many non-commercial sources, which is one reason why it is so popular.

PLA is a deteriorating plastic material that has gained traction with 3D printing for this reason. It can be used in resin format for DLP / SL processes and in the case of FDM process filament. It is offered in a variety of colors, including transparent, which seems to be a useful option in some 3D printing applications. However, it does not last as long or is as flexible as ABS [13].

### Customization

3D printing processes allow bulk customization - the ability to customize products according to individual needs and requirements. Even within the same building room, the 3D printing environment means that many products can be produced simultaneously according to the needs of end users without the cost of additional process [14].

### Complexity

The advent of 3D printing has seen an increase in productivity (designed in digital environments), including levels of complexity that cannot be physically reproduced in any other way. While this benefit has been taken by designers and artists to have an impressive visual effect, it has also had a profound impact on industrial applications, where applications are being developed to create complex elements that appear simpler and more powerful than their predecessors [15]. Significant application emerges in the field of aerospace where these issues are of paramount importance

### Tool Less

Manufacturing industry, one of the costs, time and labor, the deeper stages of the product development process is the production of tools. For low to medium volume applications, industrial 3D printing or additional production can eliminate the need for tool production, therefore, costs, lead times and associated work [16]. This is a very attractive composition, a growing number of producers are taking advantage of it. In addition, because of the complex benefits mentioned above, products and components can be specifically designed to avoid complex merging geometry and complex integration requirements that further complete the work and costs associated with assembling processes [17].

### Environment friendly

3D printing also emerges as an energy-efficient technology that can provide both natural efficiency for the production process itself, using up to 90% of the standard material, and, consequently, forming less waste, but also for every further processed product. Working life, in the form of a simple and powerful design that puts a reduced carbon footprint compared to traditionally produced products. In addition, 3D printing shows great promise in achieving a local production model, where products are produced in high demand in an area where they are needed to complete a list of large goods and non-perishable items for the export of many products worldwide [18, 19].

## 3D PRINTER PARTS AND SOFTWARE USED

### Technical Specifications:

- Printer technology: FFF
- Build base: 18\*18\*18 cubic centimeter
- Filament supported: 1.75mm P
- Nozzle Type: Metal-Hot end
- Other features: LCD support an
- Software supported: Open Source and is compatible with windows, MAC OS and Linux.

### Basic Components to Build a Portable 3D Printer [20]:

- Frame
- Linear bearings
- Linear motion
- Electronics
- Stepper motors
- Stepper motor Drivers
- End stops
- Extruder

- Timing Belts
- Pulleys and Fasteners

### Specifications, Steps and Methods

The following are the Acrylic Hi-Tech 3D printer Details:

#### Main Features

- Automatic calibration sensor is installed for ease of use
- The Hardest Frame finish with Piano Black Acrylic
- Multiple Compounds Compliant with ABS / Poly Lactic Acid / Nylon / Wood Polymer / Polypropylene
- Simplified Structure means quick integration and easy adjustment
- All metal pulleys to improve performance and performance
- Pair with LCD panel and SD card reader, Supports Independent Printing
- Weight of Object - 5 Kg
- Improved Stability and Reliability: 8 mm thick acrylic plates and all materials
- The carts ensure a stable print.
- Has new GT2560 control system Complete combination of Mega 2560 + Ramps1.4
- Has 220 X 220 X 240 mm printing volume
- Performance - Windows XP, Windows 7, Windows 8, Windows 10, Mac, Linux
- Operating environment - Temperature: 10-30 Deg.C, Humidity: 20-50 Deg .C
- Frequently Used - Suitable for Various Customers, Small or Old, Professional or Mater, etc.

#### Specifications

- Type: DIY
- Engraving Area: 220 X 220 X 240mm
- Frame Material: Acrylic Plate
- Platform Board: Aluminum Base
- Nozzle Quantity: Single
- Nozzle Diameter: 0.4
- Layer thickens: 0.1-0.3mm
- Memory Card offline Print: SD card
- LCD Screen: yes
- Print Speed: 100mm/s
- Supporting Material: ABS, PLA, Nylon PVA, PP, Wood
- Material Diameter: 1.75mm.
- File Format: G-Code, OBJ, STL.
- XY-Axis Positioning Accuracy: 0.012mm
- Z-Axis Positioning Accuracy: 0.004mm
- Voltage:12V

#### Extruder

The 3D printer extruder is a fiber feed machine used in many 3D Fused Filament Fabrication (FFF) printers. There are several types of 3D printer extruder [21, 22]. The Bowden extruder is a type of extruder that pushes the filament even though the long and flexible tube of PTFE (Teflon) has a hot end. Another type of extruder that is also widely used in 3D filament printers is a straight drive extruder or a straight extruder, which sits near the hot end of the extruder.

#### Direct Drive

With a direct drive setup, the extruder pushes the filament directly into the nozzle.

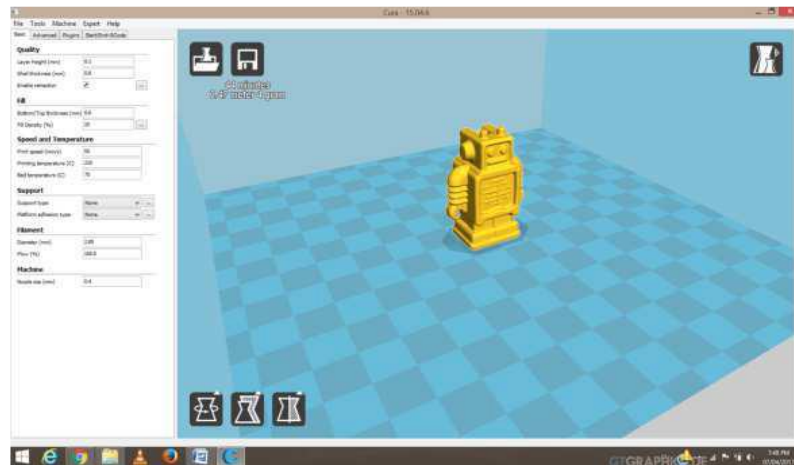
#### Bowden

Unlike in a direct drive setup, in a Bowden setup, the extruder is mounted on the printer's frame. It pushes and pulls filament through a long PTFE tube (called a Bowden tube) and into the hot end. In case of Bowden, Direct Drive is used for fast and better 3D-printing [23].

### III. SOFTWARE DESCRIPTION

#### Load a 3D model

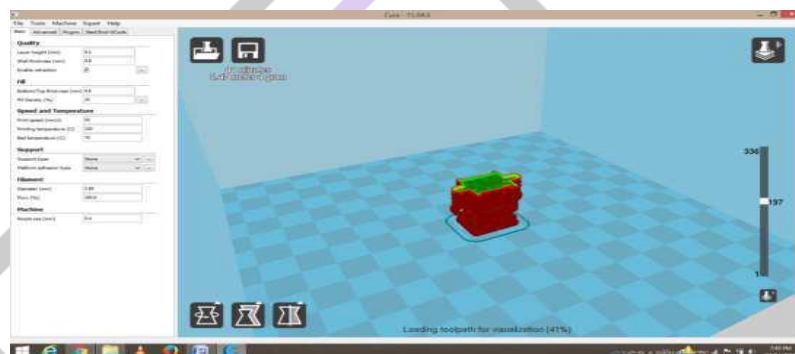
To prepare a 3D model for printing, you first load it into Cura for a Type of Machines by clicking the Load button near the upper left corner of the window. Cura for machines works with STL (Standard Tessellation Language), the 3D industry standard file format, as well as OBJ, DAE, and AMF files. The first time you open Cura for a Type Machines, a test 3D model called First Print Cone will be loaded automatically for use as your test print.



**Fig. 1:** A CAD file loaded into CURA

### Slicing and saving 3D model

After every change, you will notice a progress bar in the upper left corner. This is the slice progress. When it's done your model is ready to be sent to the printer. For large and complicated models, a slice may take a few minutes to complete.



**Fig. 2:** Slicing of 3D Model

### IV. ASSEMBLY:

The assembly is the process where, all the acrylic and the electronic components of a 3D printer are joined together with the help of bolts and nuts. The assembly of parts should be done very carefully because, the acrylic frame must have a good joint, or else, the printer will not have enough accuracy at the end, while it is used.



**Fig. 3:** 3D Printer final assembly

## V. APPLICATIONS

- 3D printing or additive manufacturing has been used in manufacturing, medical, industry and socio-cultural sectors (eg., Cultural Heritage) to create successful commercial technology [24, 25]. More recently, 3D printing has also been used in the humanitarian and development sector to produce a range of medical items, prosthetics, spares and repairs. The earliest application of additive manufacturing was on the toolroom end of the manufacturing spectrum.
- For example, rapid prototyping was one of the earliest additive variants, and its mission was to reduce the lead time and cost of developing prototypes of new parts and devices, which was earlier only done with subtractive toolroom methods such as CNC milling, turning, and precision grinding. In the 2010s, additive manufacturing entered production to a much greater extent.

## VI. CONCLUSIONS

The conclusions observed from this work are:

- 2D and 3D models of the printer parts are designed in the Auto CAD 2010 and in CATIA V5 R20.
- Fabrication and assembly of the Cartesian Co-ordinate based 3D printer is done. The main task during the fabrication and assembly is to assemble the acrylic frame because the frame plays the major role in the printing of parts with the specified accuracy.
- The Mechanical parts or any part to be printed is first designed in the CATIA software and CURA is used to slice the 3D CAD model into layers.
- 3D sliced Mechanical parts are printed 3D printer using PLA material with the help of interface software.

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