3D Printer Information

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What is a 3D printer?

A 3D printer is a device which converts your digital designs into tangible objects. This means that you can have a model of your design(made our of plastic) in a few hours without you having to do anything. All you have to do is design your object, select print settings and hit the print button!

How does a 3D printer work?

Most of the desktop 3D printers print using a process called FDM(Fused Deposition Molding) or FFF(Fused Filament Fabrication). What this means it that the 3D printer builds up your object/model layer by layer by fusing different layers of molten plastic. Just like a normal(2D) printer prints on paper and moves along 2 axis (X and Y. Much like graphs), a 3D printer moves along 3 axis (X,Y and Z). Think of this as many of the same 2-D printed designs stacked one on top of the other! Similarly, a 3D printer draws the base of your object, moves up a bit and draws another layer of the same object on the layer underneath it!Thus forming your object layer by layer.

So how to convert a design to a model once I have a 3D printer?

It's simple! Once you are done designing your object/Model in a CAD software(Solidworks, AutoCAD, SketchUp,ProE,etc), you have to export the design in a format called STL(Stereo Lithography).Don't worry about the big name - It's the same as exporting your Microsoft word file in the docx format! All "stl" does it that it describes your object's surface geometry in the form of triangles and vertices. Once you have exported your design file as an stl, you can close your CAD application and launch the software which you got with your 3D printer. There, you have to import the stl file of your object. You should be able to see it! In the software, you should be able to select infill(how dense you want your object to be) , At what resolution you want to print, at what speed you want to print and finally, with what material.

What does the software do?

The 3D printer software establishes a connection between your computer and your 3D printer via USB/Serial. These softwares take your design "stl" file as an input and accepts all your configurations of resolution,material,etc. After you've finalized your configuration, it exports something called GCODE. GCODE is instructions for your 3D printer- What coordinates to travel to, calculate and start extruding plastic out of the hotend. You can also monitor your 3D printer via these softwares as they display all the feedback which they receive from all the sensors on the printer.

The following are the main components of a 3D printer. These can be found in different designs and orientations. But the basic concept is the same.

Controller Board with onboard microcontroller, stepper motor drivers and other components:

This board(circuit board) is the "brain" of the 3D printer. It accepts GCODE and accordingly instructs different components to perform different functions. It also takes feedback from the sensors and sends it to the computer. It is your translator and commander for 3D printing! It has various components like the Micro-controller which is programmed with firmware, stepper motor drivers, MOSFETS, etc.

Stepper Motors:

A stepper motor divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor. A 3D printer usually has stepper motors to control the independent movements of the X, Y and Z axis and to control the extrusion of plastic.

Hotend Assembly:

The hotend assembly consists of 5 main components.

1.) **Nozzle-** this is the component through which the semi-solid plastic comes out and falls onto the base plate(hot bed) on which the object is being printed.
2.) **Heater Cartridge** – this component heats up to temperatures required to melt the plastic when current is passed through it.
3.) **Thermistor** – This is a temperature sensor. It continuously monitors the temperature of the heater block and sends it to the microcontroller.
4.) **Heater Block** - The heater cartidge and thermistor go inside the heater block. The nozzel is attached to the bottom of the block. It's just a heating component which converts solid plastic to semi-solid plastic.
5.) **Insulator compartment** – This part ensures that plastic doesn't melt in advance and block the heater block and nozzle.

Extruder Assembly
This assembly houses the mechanism which pushes the plastic into the hotend assembly. The extruder assembly consists of a stepper motor, a drive gear and several bearings, nuts and bolts. The hotend assembly is attached to the extruder assembly.

End-Stops
Usually, there are 3 end-stops in a 3D printer. These are basically just limit switches or optical sensors which tell the printer the maximum co-ordinates to which it can travel in a particular axis. Thus the name "End-stop".

Heated Build Plate
While printing plastics like ABS which melt at high temperatures, one requires a heated base plate on which the plastic is being deposited. It is heated just to make the semi-solid plastic stick and avoid warping of the print.

Apart from these parts, a 3D printer has several types of rods and structures as guides/frame , several types of bearings(linear as well as ball bearings) and a lot of assorted nuts and bolts. It also has timing belts and pulleys to make attached to the moving axis parts to make them travel to particular co-ordinates.

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