

Open-Source in 3D Printing

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A couple of years ago, I was reading an article about MakerBot. They were developing an early open-source 3D printer. The company was having problems maintaining a constant temperature at the printhead. One of the members of the open-source community involved in this project was an expert on software techniques to manage dynamic systems. He submitted suggestions to help improve the software to maintain a more constant temperature. This demonstrates one of the more powerful aspects of an open-source community. You don't have to only rely on your in-house experts. The whole community helps to improve the project. This also means that support for your project or product also tends to be community based in an open-source environment. When I had problems with my Anet printer, there was very little information at the company website, but a great deal in the dedicated discussion groups.

Definitions

open-source is software or hardware where the source code or design is freely available for download, study, modification, and redistribution. Any improvements should be also freely available and submitted back to the originator.

<https://opensource.org/docs/definition.php>

3D printing is the process of creating a real world object by laying down successive layers of material. This is called additive manufacturing as opposed to milling or woodworking which is a subtractive process. The 3D additive process most often used in the classroom is Fused Deposition Modeling (FDM).

History

3D printers are a form of CNC machining. CNC stands for computer numerical control and has been around since the days of punch cards in the early 1950s. The designer uses a computer to turn a design into a series of commands that directly control the movement, speed, and tooling of the machine, In our case, a 3D printer. This series of commands is in a standardized language called G-Code. Using a computer to aid in the design process CAD started in the 1960s when the IBM mainframes became available.

In 2004 a Open-Source 3D printer project was started called RepRap. In this project, the goal was to produce a printer that could make a significant percentage of the parts necessary to produce another printer. Where it can't make its own parts, it uses commonly available off the shelf parts that the maker community is comfortable with.

Further reading:

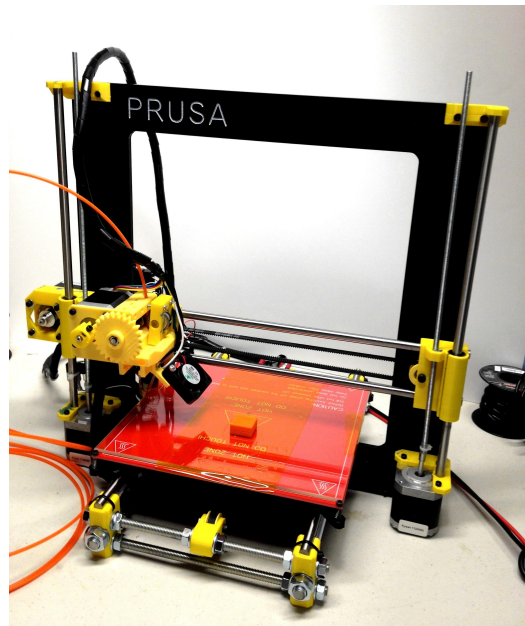
[Diary of a Technocratic Anarchist](#) - pdf

[A History of RepRap Development](#) - pdf

Technology

Cartesian printers Cartesian printers use a three-dimensional grid system to define points in space. A separate motor controls each axis: X, Y and z. There is typically a build plate that can move along the y axis and a gantry above that which moves along the x axis. The z-axis can be assigned to either the build plate or the gantry. The Prusa i3 is an example of an popular open-source printer that uses this system.

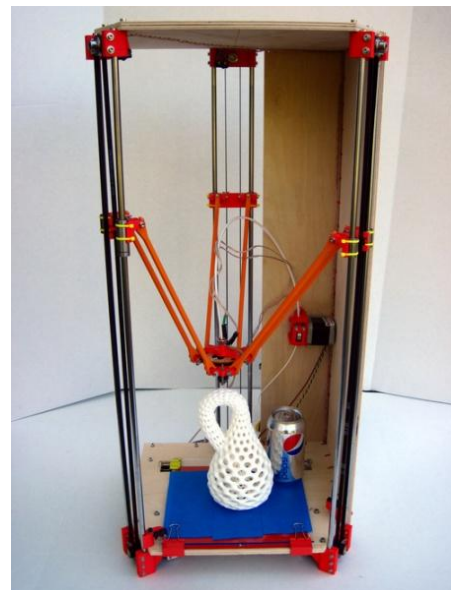
[Prusa](#) - an open-source cartesian printer.



Delta printers A delta printer uses three paired control armatures 120° apart, each of which can be raised or lowered independently. These three control structures have two rods connected to universal joints. These create a parallelogram structure for each controller keeping the triangular work platform parallel to the base while it is moved in a 3D space.

[Rostock](#) - a open-source Delta printer.

[Cartesian Vs. Delta Printers: How Do They Work?](#)



Controller - Most open-source 3D printers use the [Arduino](#) development system as their on-board computer to control the printing. Arduino is an open-source hardware development system that uses the Atmel microcontroller chip. The software built into a dedicated device such as a printer is called firmware. The firmware in my open source 3D printer got corrupted and I had to reinstall new software into it. I also have the option to install other software into my printer with other features. This is another aspect of open-source projects. I have the opportunity to try other firmware that may have additional functions or quality to improve my product.

Leaders

Some companies that have been leaders in open-source 3d printing are Ultimaker, LulzBot and RepRap. Makerbot was an early leader in open-source 3D printers but then went closed and proprietary.

[Ultimaker](#) The Ultimaker produces high quality 3D printers with a dedication to open-source goals and is known for creating and maintaining one of the most used open-source 3D slicing and printing software applications - [Cura](#).

[RepRap](#) “RepRap was invented by Adrian Bowyer and the idea first appeared online in February 2004.” The word RepRap is short for replicating rapid-prototyper. It is a 3D printer that can make a significant percentage of the parts needed to make a copy of itself.

[Prusa](#) The Prusa i3 is a very popular 3D printer. It was originally based on the RepRap design and has been copied many times by other companies making low cost 3D printers including the one I purchased - the [anet A8](#).

[LulzBot](#) is also known for high quality printers with a commitment to open-source.

Software

CAD

[OpenSCad](#) - This is a CAD program that is command based rather than using mouse/graphics to create models. This can make it more precise but much harder to learn. For example to create a cuboid, the user would enter the command `cube([2,3,4]);` instead of drawing the object.

[FreeCad](#) - FreeCAD uses Graphical User Interface to add and modify objects.

3D Modeling / Mesh editors

[Blender](#) - Blender is a 3D creation suite targeted at creating 3D scenes and video. The 3D tools are very powerful. They can be used to create 3D objects to be exported for printing.

[Art of Illusion](#) - Art of Illusion is a 3D modelling and rendering studio.

[MeshLab](#) - MeshLab is a 3D mesh editor.

Slicing and printing

[Cura](#) - Cura prepares a 3D model for printing and creates the G-Code to send to the printer. It has over 200 settings that can be adjusted to get the most out of your printer.

[Slic3r](#) - Slic3r also prepares a 3D model for printing and creates the G-Code to send to the printer.

Not open-source, but free to students:

[TinkerCAD.com](#)

[3dc.io](#)

[3dslash.net](#)

[sculptGL](#)

[AutoDesk Fusion 360](#)

Firmware

[GRBL – Motion Control for Makers](#) - GRBL is a core CNC app that runs on an Arduino and from which many forms of DIY CNC machines can be built.

[Marlin](#) - another common firmware

[SkyNet3D](#) - includes auto leveling

Culture and Manufacturing

Open source and 3D printing both lead to a shift away from the factory manufactory model of production that we have had since the industrial revolution. Smaller production systems that are more nimble and customisable are becoming more realistic with open-source and 3D printing.

Conclusion

I have been an open-source advocate and user for years. The one thing I found disappointing in getting into 3D printing was that I had to boot Windows and use commercial software with it. I like the non-commercial aspect of open-source software and hardware and the ability to dig in and Tinker with it. So, I started doing my research on what was available in the open source community to support 3D printing. I ended up purchasing a [Anet A8](#) 3D printer which is an open source clone of the more common Prusa i3 printer. Another advantage of going with an open-source design is that parts and upgrades are readily available online. I can't say that building a 3D printer from a kit is the best solution for a classroom. However, building it myself combined with my background in CNC woodworking and robotics gives me a very deep understanding of how the printer works and how to keep it running.

Extra Goodies

Add on to color filament on the fly - <http://www.thingiverse.com/thing:77424>

Eventorbot! Open source 3D printer
<http://www.thingiverse.com/thing:28915>

Three reasons for open source tech in your 3D printing classroom
<https://ultimaker.com/en/blog/38397-three-reasons-for-open-source-tech-in-your-3d-printing-classroom>