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КАК ПОСТРОИТЬ СВОЙ ПЕРВЫЙ 3D ПРИНТЕР И СВОЙ ЛЕКСИКОН

HOW TO BUILD YOUR FIRST 3D PRINTER AND YOUR VOCABULARY

В данной статье рассматриваются основные этапы создания 3D принтера, использующего экструзионную технологию. В последнее время 3D печать быстро развивается и внедряется повсеместно. Я хочу поделится своим опытом в создании подобного устройства. Также в данной статье описывается влияние этой новой технологии на язык. Поскольку основной язык, используемый специалистами в данной области – английский, то много слов просто заимствуются. Например, такие термины как экструдер, хотенд, заслайсить, стопенд и многие другие перешли в русский язык и используются специалистами ежедневно. Возможно, в будущем они будут замещаться новыми терминами или останутся в языке как неологизмы.

Firstly what is 3D printing? This is a process of manufacturing three-dimensional solid objects of virtually any shape from digital model. This is an additive technology, instead of removing all extra material from blank it adds material in order to build an object. Nowadays 3D printers are spread worldwide and coming to any prototyping.[1] That is because you can easily make any part for your structure just making a 3D model in any 3D modeling program like AutoCAD, FreeCAD, Solid Works, Blender, 3DMax, etc. Then you need a program called slicer for slicing your model to layers and an operating program for using your printer. Also this technology is becoming a household appliance, many people already have 3D printers at their homes, and many are going to.[2] So I am building mine too and would like to share my experience in this area.

There are several different processes of 3D printing. These are Digital Light Processing (DLP),Stereolithography (SLA), Laminated object manufacturing (LOM), Plaster-based 3D printing (PP), Selective laser sintering (SLS), Selective laser melting (SLM), Direct metal laser sintering (DMLS), Electron Beam Freeform Fabrication(EBF3) and Fused deposition modeling (FDM), so called extrusion technology.[2] Also there are 3D printers that can print with chocolate, metals, concrete, tissues.[3]

The most used process is extrusion. The idea of this is pushing plastic through a heating nozzle where plastic melts and goes out. The nozzle moves to build, layer by layer, the solid object. The process can be compared with a precise glue gun. This is the most widespread technology nowadays. To start with building our own 3D printer we need to choose what kind of printer we are going to build.[4] There are some types of extrusion printers that differ by the way the printer positions its nozzle. These are printers with the heating platform going Z-axis and the extruder going XY-plane or with platform going X and extruder going YZ. Also there are delta printers based on 3 sticks with ends connected to threated rods and moved in Z-axis, but difference in those movements results in the extruder movement in space. And there is a plenty of models for each of these types.

To find out what printer is the best for your purposes it is helpful to read about them on their web pages and forums. Making your choice you should find out what machinery you have access to, because usually to build 3D printer you need a 3D printer. That is ideology of RepRap community, that develops self replicating printers, containing printable plastic parts. Also there are some printers like MakerFarm's, GRABERs that require only laser cutter for manufacturing all the parts.[5] Then the choice is whether you would like a durable construction that has been probed by many users, has detail assembly documentation and complete bill of materials (BOM) or a brand

new one that has less documentation, something that just resembles BOM and does not have all required parts. For the first choice you can surf RepRap web site and find your printer with complete documentation. The other one can also be found there or on other web sites like Thingiverse or other.[1] By the time, you have chosen your printer, found machinery, downloaded all source files, you are ready to start.

The first thing to do, when you have all source files: printed parts, frame, etc. is to check that the structure is possible to assemble. For this you can assemble it in any engineering program like FreeCAD, or if you have perfect imagination, assemble it in your mind. Then if you found out that something is wrong, do not worry it is a common problem even for checked model, because all of them are developing every day and some new changes have been applied without check. You can look for the proper parts in sources, but if they are not available, you can surf forums for the solution and you will find it.

Then read the BOM precisely and check that you can buy everything in your city. Then think how can you replace materials, that are hard to get. The most expensive parts are steppers, hotend (heating nozzle) and electronics (Arduino board, RAMPS1.4, heating platform,etc.). All other parts you can manufacture yourself. Then waiting for the electronics delivery, you have enough time to assemble the mechanical modules. My experience is with Prusa i3 3D printer, further I will use its assembly steps as an example.

Firstly you need to assemble the frame, then build X carriage, place smooth rods into linear ball bearings and install it on the frame then securely fix rods. Then you need to connect Y carriage to linear ball bearings and place them on Y smooth rods, then connect the stepper mount on one end and the coupling on the other. Then you need to place the entire structure on Z rods and fix them. Then assemble the extruder (hotend with pushing screw, gears and stepper) and fix it on the Y carriage. Now you can go on, placing steppers on their places. Then you need to buy or print pulleys, find belts and install them. So you have all mechanical parts together.

Now we need something that will control our printer. The most common solution is Arduino board with RAMPS1.4 3D printer controller. Also you will need some usual tools like drill, screwdriver, solder, marker, side cutters, zipties and multimeter. The good thing to start with is to install a power supply to your printer. Then attach power supply wires to the connector on the RAMPS board and place the Arduino with RAMPS on the side of a printer. Attach crimp housings to steppers' wires. Use your solder to connect the heating platform to the RAMPS and install the thermistor to the platform. Then do the same thing to the hotend. Then, using screwdriver and multimeter calibrate stepper controllers on the RAMPS board. Then install stopends to the exact places on axises and connect them to the board. Finish wiring making all wires looking well using zipties. Now clamp a piece of glass to the platform and stick Kapton to this glass. Well done, we finished the assembly.

Now it is time to calibrate the printer. For this process install Arduino IDE and upload the firmware to the board. Install printer software to your computer. For every type of firmware there are software programs for printer operation. Use this software to calibrate the firmware so that the distances in program are the same with the real distances, the printer moves. Then calibrate the machine zero by moving stopends on the axes to the right place, corresponding to the platform corner. Now you need a slicing program like Kisslicer or Slic3r or anything else. For every printer you need to setup your slicer by entering size of the platform, nozzle diameter, filament diameter, operating speed, etc. Then you need to write some code for printer initialization in order the slicer would know what to do before printing. For that you need some programming skills and a G and M-codes reference, which you can find in the web. These codes are the same for every printer, but not every command is understood by the printer firmware. Usually this process takes about a day to write this code.

Now it is time for printing. You can download any model from Thingiverse, slice it and print.

For first prints the best object is so called calibration cube. It is just a cube, but after printing it you need to measure its size and check that the printer operates properly and all dimensions are correct. Cool, there is one more 3D printer in the world.

The other question is to find a place to do all this work. People do that at their homes, in garages but mine is being build in the Fab Lab Polytech (fabrication laboratory), that gives students an opportunity to implement their technical ideas.[6] It was set up in May 2013 and is part of SPbSTU.

3D printing brings new vocabulary and building it you should read the documentation, but the language of 3D printer makers is English. So people, who work with them use specific terms. Building a 3D printer you can also build your vocabulary.

Some of these terms are abbreviations, that require clearification. For example BOM – bill of materials, IDE - integrated development environment, FDM - fused deposition modeling (extrusion method).

Some are merges of everyday words e.g. firmware – is a build-in program that provides link between the printer and the computer, zipties – small plastic parts that can fix anything, steppers – electric engines that can turn on an exact angle, stopend – is a sensor, that tells the printer if it hits the end of an axis.

Besides common words acquired new meanings: slicer – program that is used for slicing the model and generation of operating track, extruder – mechanism that takes, heats and extrudes filament, filament – is any type of material, that has ability to be used for 3D printing in form of a thread, machine zero – the point on a working area, that printer uses as a zero point, RAMPS is an extension shield of Arduino board that gives it a way to operate printer's steppers and sensors.

Brand names like Arduino – a trades name of easily programmable board, Kapton – the special material that prevents parts from detachment, Thingiverse – web site, where people from over the world upload things that they have developed.

In 3D printing there are many terms that specialists use without translation. It usually sounds strange like “Заслайсить модель”, but there is no other simple way to tell this. These terms may stay in language as neologisms
or cad be replaced with new ones.

In this work the main steps of building your first 3D printer are described. 3D printing is not only a prototyping technique, it is a really exciting hobby, that will keep you interested for a long time. Also analysts say that a pay-back period for a 3D printer is about a year, so this hobby will not make a lasting hole in your pocket. After building your first printer you are free to build a better one by printing special extra parts for yours or for a completely different machine, and reassemble the new printer. Reassembly requires no addition in electronics, since most printers have the same. So printers have a capacity of using parts from the previous one to build the next generation. Do not hesitate to join the 3D printing global community with a lot of interesting people. You will be very welcome.

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