By Tiberius Brastaviceanu, Tyler Sloan, add your name here

Micro 3D Printer - main doc

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Design and build a Micro 3D printer.

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Tyler's project might use this 3D printer.

Path

1. build first prototype
2. crowdfund
3. build beta product

Development

Open the R&D and prototyping document

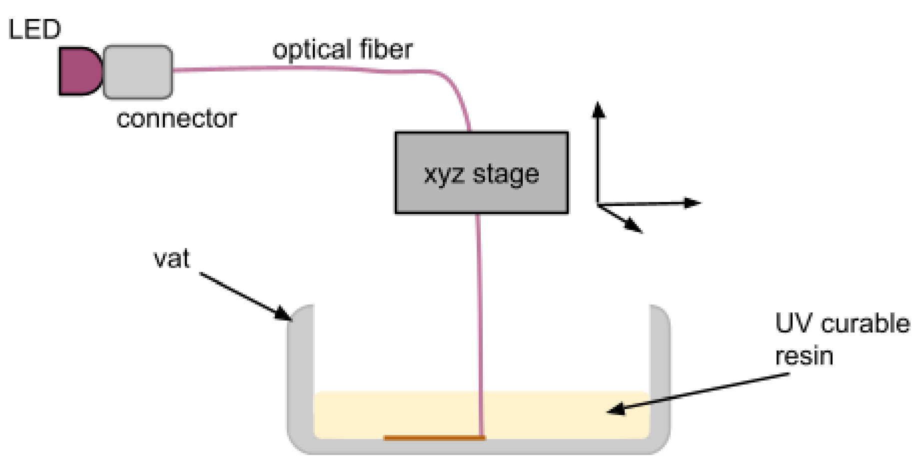
Main components

Piezo motors

See all piezo-based actuators and motors that can be integrated into an xyz platform with sub-micron spatial resolution.

We need to make a xyz piezo stage compatible with the G-Code, to make it compatible with all 3D printing software. For proof of concept Tibi can write a LabView program, since almost all our piezo actuators and motors already have LabView interfaces. This can be used to print simple shapes.

Optical and mechanical assembly



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Initial Market reflections

[Remix by Tibi from Tyler, July 2012]

Demand for user-friendly microfab tools

The Micro 3D printer definitely has potential! In academia, people have struggled for years trying to obtain sub-micron resolution in their fabrication, where the cost increments significantly when one moves to that scale. It ends up being cost-prohibitive to do some of the experiments people would love to be doing. There are entire fields of biology that would benefit from the availability of such a technology.

Despite the fact that scientists are genuinely interested in using microfluidics to miniaturize their experiments, the big boundary is that most biology labs don't have access to microfabrication facilities, so it becomes difficult or impossible for them to get started. There is a lot of value in a user-friendly machine that a lab can purchase without having to hire engineers to run. Also, granting agencies throw money at startup labs for equipment, and sometimes they can have trouble spending it all (since it can't be used to pay a salary, only equipment). It helps our case even more that they're used to paying extreme prices for equipment like high-end microscopes, so a micro 3D printer might not be so hard to sell.

Without being an authority on the subject, my experience as a graduate student (bioengineering, working with lab-on-a-chip) leads me to believe that the biggest benefit that rapid prototyping of microfluidic devices has is in the customizability. For example, if someone is using a device and they come up against an issue because the channels aren't long enough, they could change the dimensions and 3D print again (the object or the mold), and be able to try again in an hour or two. Tibi and Daniel did 4 design-fabrication-testing loops in 2 hours with THIS microfluidic device printed with a B9Creator (DLP 3D printer). Currently, using standard techniques, a new design would probably take at least a few weeks before they can be experimented with, and cost a whole lot more.
In the beginning, we need to start with a 3D printable area approximately the size of a glass microscopy slide.

This is a very interesting path for microfabrication (bioplotting), especially for microfluidics, and we're not too far from the finish line!

Potential synergy: online sharing platform

Another huge benefit would come from a repository of publicly available designs collected from scientific and engineering publications. In this way, a researcher can see a device used in a paper, find it or a similar one in an online catalogue then print a mold. They can then test it out, and modify it to to optimize it for their purposes. Offering a community and sharing online platform around the printer itself would create a tremendous synergy with the micro3D printer.

In the case that someone is interested in a design that is not available in a repository, but is found in a publication figure, there is a lot of potential value in a tool that would allow the dimensions/geometry of the design to be extracted from an image and outputted as a CAD file. This could likely be accomplished using edge-detection algorithms in imageJ; a plugin built to serve this function would be an excellent resource to rapidly expand the online repository by crowdsourcing the task to the micro-3D printing community at large. A growing online repository/sharing platform would be encouraging for researchers interested but undecided on purchasing a micro3D printer, and the resulting feedback loop could generate synergy in the demand and market value of the micro3D printer.