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Global team develops open-source N95 respirator

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The mask's rigid components were printed at UMass Amherst's ADDFab laboratory. Credit: UMass Amherst

In one of the latest COVID-19 response projects at the University of Massachusetts Amherst, the Advanced Digital Design and Fabrication

(ADDFab) laboratory is collaborating with a global network of design, engineering and manufacturing experts to help develop an open-source N95 face mask.

ADDFab, one of the core facilities at UMass's Institute for Applied Life Sciences, has been rapidly preparing 3-D prints of prototype parts and molds for Cofab Design in Holyoke. Cofab business partner and design engineer Aaron Cantrell is one of primary leaders of the Open Standard Respirator (OSR) project, a "nonprofit effort to broaden protective equipment supply for COVID-19 and beyond." The other leaders are biomechatronics engineer Matt Carney of the MIT Media Lab Biomechatronics Group and Philip Brown, assistant professor of biomedical engineering at Wake Forest University Baptist Medical Center.

Attracting industry professionals who teamed up from around the globe, the community-driven project grew out of a grassroots desire to address the critical shortage of N95 masks caused by the pandemic. "There was a huge increase in demand that was beyond the ability of existing manufacturers to keep up with in a quick way," Cantrell says. "Existing designs were locked up behind intellectual property walls, which prohibited manufacturers who wanted to chip in from producing them. Core to our ethos was an open hardware approach, which allows anyone with the manufacturing capability to license the design, producing a larger ultimate impact."

Cantrell and Cofab's two other partners, Mike Stone and Jake Horsey, with whom ADDFab has previously worked, needed a prototyping partner that could produce prototype molds overnight and economically for the modular, reusable, filtering face piece respirator. ADDFab student workers were able to turn around prototype pieces in both laser-sintered nylon and UV-cured polymer the day after the designs were digitally received in the lab.

"This project is a really good fit for our lab," says ADDFab director David Follette. "We can use high-end printers to print molds for silicone parts, which have very demanding requirements for accuracy and surface finish."

Both Follette and Stone agree that the ongoing, local working relationship between ADDFab and Cofab quickly pushed the project forward. "To get prototypes that quickly from a third party or online service bureau would just be astronomically expensive, and then require overnight shipping," Follette says.

"There was a huge amount of pressure to do this quickly, and we were sprinting to get things done," Stone says. "We had a trusted relationship with someone within driving distance from us who can deliver high-quality components using world-class materials and processes. This was the best-case scenario."

Among other parts, ADDFab printed the mold tooling for the silicone face piece, allowing Cofab to test it out before committing to expensive metal tooling necessary for mass production. Utilizing this workflow and ADDFab's printing expertise, the team was able to rapidly revise the facepiece design and test out many variations in the course of hours, rather than waiting upwards of a week for each design iteration.

"By locally 3-D printing the molds and testing them quickly, they could be much more confident in their design when beginning to manufacture at scale," Follette explains.

Cofab used the prototypes to finalize their design of the mask, which is now being field-tested at sites around the world. "It's free for people who want to produce it," Stone says. "At the end of the day, we want safe, reliable PPE to be in the hands of more people."

A nonprofit will hold the license for the respirator design, and the makers will be responsible for seeking any certifications or approvals, if desired.

"On a bigger-picture front," Stone says, "this is how open-source medical products might be able to work in the future."

Provided by University of Massachusetts Amherst