# Wireless sensors for N95 masks could enable easier, more accurate decontamination

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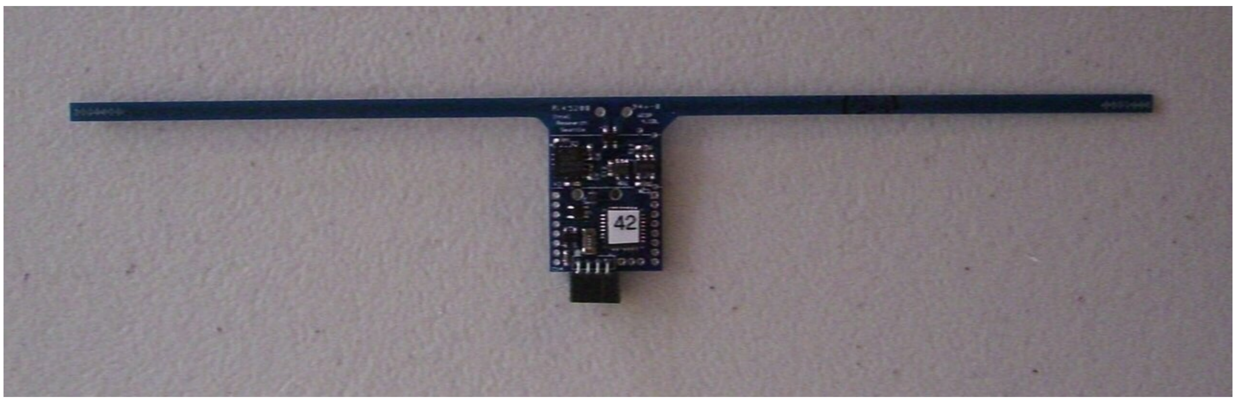

Credit: University of Michigan

Tiny wireless sensors for recycled N95 masks could verify, in real time, whether the respirators are being exposed to proper decontamination conditions.

They're being developed and tested at the University of Michigan through a new National Science Foundation RAPID COVID-19 grant.

The batteryless sensors are designed to provide more accurate and less cumbersome monitoring during the decontamination of protective masks for medical workers. In an effort to ensure availability of N95 masks when supplies are still tight, the devices help to ensure sufficient heat and humidity is used in decontamination systems.

"Think of these wirelessly powered sensors as a turkey pop-up indicator for when decontamination is done," said Kevin Fu, associate professor of computer science and engineering at U-M and lead on the project.

Previous studies have demonstrated that certain combinations of temperature and humidity are effective for decontaminating N95 masks adequately without damaging their performance or fit. Too much or too little intensity, however, can make a mask unsafe for continued use.

"The ovens used to decontaminate these masks can produce cold spots and dry spots, so it's important to verify the decontamination conditions with a resolution of a few cubic inches," Fu said.

Current methods to achieve this accuracy are both labor-intensive and damage-prone. The most typical setup involves installing multiple wired sensors inside each of several dozen cubby holes designed to decontaminate one mask at a time. The result is an oven with a huge coil of wires draped through a portal, and an unwieldy setup for operators to work around.

This project proposes replacing this with small, wireless chips that can be sprinkled in each cubby hole once and monitored with an adjacent device. The chips make use of energy-harvesting circuits from Fu's past research on wirelessly powered and secure RFID sensors.

"We want to remove messy spaghetti wiring from the decontamination stations," Fu said.

Because of the wire nuisance, these sensor setups are typically used for a brief calibrating phase early in the oven's installation and then removed. Fu's proposed solution can remain installed to allow ongoing monitoring of the oven's calibration, as well as enable potential future features such as real-time feedback to the oven's temperature control.

This project plugs into a larger national effort to provide guidance to health care professionals on best practices for decontaminating their personal protective equipment. Called N95decon.org, Fu contributed to the launch of the effort along with U-M's Nancy Love, the Borchardt and Glysson Collegiate Professor of Civil and Environmental Engineering, and nearly 60 other scientists, engineers, students and clinicians around the world.

Love is working on a project comparing various mask decontamination methods. That work could potentially benefit from Fu's wireless sensors.

"The wireless, batteryless sensors confirm when heat, humidity and time targets have been met for decontamination," Love said. "The technology can give users the confidence they deserve when reusing respirators or other PPE."

The researchers hope the sensors will prove to be a more scalable method for monitoring mask decontamination, ultimately cutting down on wasted time and resources across the country.

"We need this science and technology so healthcare workers can return their focus to patient care instead of worrying about masks," said Manu Prakash, professor of biomedical engineering at Stanford University and leader of the N95decon.org team.

Fu said this project has broader application to related domains for COVID-19 such as decontamination of automotive fleets, public transportation and passenger aircraft by reducing the cumbersome and unsightly wiring to inconspicuous canary sensors that verify the environmental conditions needed for decontamination.

The project is a joint effort between Fu, Ph.D. student Yan Long and co-principal investigator Sara Rampazzi, who recently accepted a position at the University of Florida.

Provided by University of Michigan